Theme:

Recycling and Redefining the Green Environment for Clean Future

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Keynote Forum

Day 1

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Lin Chen

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University of Chinese Academy of Sciences, Beijing 100049, China

Supercritical CO_2-Based Energy System: Fundamental Issues and Challenges

Supercritical fluid has been widely proposed and utilized in energy systems in recent years. For renewable sources such as solar energy conversion, the supercritical fluid can be operated with high temperature and very compact design to achieve higher conversion efficiency in power generation Brayton cycles. In real applications, there have been several representative kinds of CO2 based Brayton cycles around the world. However, the efficiency is still a big problem in the development of such systems. The current talk will focus on CO_2 based energy systems and present the basic design, efficiency analysis and explorations of the key factors that control the system performance. Detailed experimental and numerical developments in the Brayton cycle and also fundamental parameter analysis will be explained. Furthermore, the fundamental cross-critical process and the physical reason for the efficiency challenges of such cycles will be presented in this talk.

BIOGRAPHY

Dr. Lin Chen is now a full professor in the Institute of Engineering Thermophysics, Chinese Academy of Sciences, China. He is currently one Board member of the Experts Commission of China Energy Society. He was previously an Assistant Professor in Tohoku University, Japan. He obtained his B.E and Ph.D. in Energy and Resources Engineering from Peking University. His research topics include energy resources, supercritical fluids, soil remediation, and advanced measurements. He has authored over 140 well-cited international journal papers and/or conference presentations, and 7 chapters, 3 books, including the most famous one on energy conversion ("Advanced Applications of Supercritical Fluids in Energy Systems", IGI Global, 2017, 680 pages). He was the winner of the Young Scholar Award of the Asian Union of Thermal Science and Engineering (AUTSE) in 2018. He is currently an AE of the ASME JNERS and an Editorial Board member of the Journal of Supercritical Fluids (Elsevier).

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Gintaras Šiaudinis

Lithuanian Research Centre for Agriculture and Forestry, Vėžaičiai Branch

The perspective of different energy crops cultivation under less favourable for traditional agriculture Western Lithuania's *Retisols*

With the growing demand for alternative energy (especially plant biomass) and to avoid competition with traditional food crops, part of the less-favored areas may be used for energy crops. LAMMC Vėžaičiai branch (Lithuania) has been conducting research on 2 perennial fast-growing plant species (herbaceous and woody) in the acidic whitish soils (pH 4.2-4.4) of Western Lithuania since 2009 and 2014.

The effect of liming (to adjust the optimal soil pH level) and nitrogen fertilizers on biomass growth was investigated. The increase in dry weight of cocksfoot (*Dactylis glomerata* L.), reed canary grass (*Phalaris arundinacea* L.) and common osier (Salix viminalis L.) was directly related to nitrogen fertilization alone. Liming and fertilization with nitrogen fertilizers and their interaction had a positive effect on the productivity of the following plants: black poplars (Populus nigra L.), cup plact (*Silphium perfoliatum* L.), virginia mallow (*Sida hermaphrodita* Rusby). Except for virginia mallow, the effect of liming on other plants is more pronounced only in the first few years of plant growth. However, primary soil liming had a positive effect on soil chemical parameters (especially humus growth) and microbiological activity.

In the second field experiment, the influence of waste raw material - sewage sludge on the productivity of common osier and cup plant was investigated. The research data show that after fertilizing these plants once with sewage sludge, the positive effect on biomass growth remained 7 years after planting. The content of humus, mobile nitrogen and especially mobile phosphorus increased substantially in the soil. sewage sludge improved soil physical properties and microbiological activity.

To evaluate plants energetical parameters and soil quality changes, the research into these energy crops will continue for several years ahead.

BIOGRAPHY

Dr. Gintaras Šiaudinis is a scientific worker since 2007. The main interest of research: energy crops; their adaptivity under local soil and climatic conditions; plant biomass conversion to biofuels. The author has publisher 19 scientific publications in magazines indexed in *Clarivate Analytics Web of Science database.*

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Plastics Awareness for Sustainable Development

Dr. S. Ravichandran

Associate Professor in Chemistry, Lovely Professional University, Punjab-144 411(INDIA)

Accumulation of plastic products in the Environment that adversely affects wildlife, habitat of humans is a major concern for the government at present. As plastic is non-biodegradable in nature, it remain in environment for several years. As a result it is responsible for causing land, air and water pollution. Plastic pollution has been constantly damaging our sustainable environment. The production of plastic is increasing since 1950, 8.3 billion tones of plastic has been produced, which is likely to be double by 2050. The burning of plastic waste increase the risk of heart disease, damages the nervous system, respiratory ailments such as asthma and cause nausea or headaches. Hence, a sustainable step towards tomorrow's greener and healthier environment needs immediate attention of the environmental scientists. Most of the environmental tools of plastics like cell phones, computers, helmets and hospital bags have molded society in many ways that make life both easier and safer. Plastic produced every year is used to make for single use, disposable packaging items or products when they are thrown out which damage the green environment. It is due to lack of self discipline and not worrying about future generations, selfish attitude and consumerist human has damaged the environment. It is the responsibility of educational institutions to sensitize and create public awareness. In addition to creating public awareness on the importance of a clean and healthy environment, plastic recycling facilities must be recommended. This invited talk will help the society to reduce their exposures to plastics and ensure the increase of healthy society with clean environment for the next future generations.

Biography

Dr. S. Ravichandran is currently working as an Associate Professor in Department of Chemistry at Lovely Professional University, Jalandhar, Punjab(INDIA). He completed his Ph.D. in 2006 from Madurai Kamaraj University, Madurai (Tamilnadu) and M.Sc. from Pondicherry University, Pondicherry. He has qualified in GATE with a score of 95 percentile conducted by Ministry of Human Research and Development in the year 1998. He has 17 years of Research experience and published 112 International papers. He has published 5 Textbooks and received Bharat Shiksha and Life Time Education Excellence National awards from Global society in New Delhi. His area of research work are: Synthesis of Mannich and Schiff bases with metal ions like Cu(II), Co(II), Ni(II) and Zn (II). Structural characterization using spectroscopic techniques like UV-Vis., IR, 1H NMR, CV, Chromatography and EPR. His current interest is to focus on the development of novel greener methodology for a Sustainable Development.

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Biodiversity within the circular economy

Ms. Radia Sedaoui

Chief of Section, Economic Affairs, in the Climate Change and Natural Resource Sustainability Cluster of the UN Economic Social Commission of West Asia (ESCWA), Algeria)

To achieve targets laid out under the Sustainable Development Goals (SDGs), biodiversity principles must be deliberately woven into any circular economy or circular carbon economy framework (CCE). A circular economy is not only a framework (based on the 4 Rs's) for managing and reducing emissions, but rather a framework for an economy that is restorative and regenerative by design – benefiting both people and planet – and which, ultimately, helps countries, cities and businesses re-imagine progress. Biodiversity preservation involves preserving biological variety and variability of life on Earth. According to the Living Planet Index, which measures of the state of the world's biological diversity based on population trends of vertebrate species, 60% of species have disappeared in the past four decades alone. Land-use change has become the single largest driver of biodiversity loss, and approximately 85% of this land-use-related biodiversity loss is due to the cultivation and processing of biomass, including wood, food and biofuels. It is therefore essential to consider nature and biodiversity protection within any circular economy framework to reverse this trend.

While circular economy has received increasing attention, including in recent national climate pledges, the circular economy-biodiversity relationship has received little attention and the implications of circular economy on biodiversity needs further exploration. Complementary policy measures must be identified to protect biodiversity while promoting circular economy. The present paper will address and focus on the importance of biodiversity considerations within a circular carbon economy framework.

Biography

Ms. Radia Sedaoui is the Chief of Section, Economic Affairs, in the Climate Change and Natural Resource Sustainability Cluster of the UN Economic Social Commission of West Asia (ESCWA). Ms. Sedaoui has an extensive experience in energy policy advice, renewable energy and energy efficiency, energy modeling, water-energy-food nexus, economic diversification and climate change policies and technologies and energy market developments. Ms. Radia previously served as Head Statistics and Gas Modeling Department at the Intergovernmental Organization of the Gas Exporting Countries Forum and previously held several senior positions in Algeria with "Sonatrach" as Director of Strategy and Corporate, Head Portfolio management and member of the Board of Directors of Sonatrach affiliates. Ms. Sedaoui holds a Bachelor of Industrial Engineering, master's in petroleum economics and master's degree in business administration. Ms. Radia is the President of the "Arab Energy Club".

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Effect of functionalized surfaces in enhancing the output power of drop energy harvesters

Ali Ghaffarinejad, Xabier Garcia Cacas, Juan Ramon Sanchez Valencia, Carmen López-Santos, Ángel Barranco and **Ana Borrás**

Nanotechnology on Surfaces and Plasma Group (CSIC-US), Materials Science Institute of Seville (Consejo Superior de Investigaciones Científicas – Universidad de Sevilla), c/Américo Vespucio 49, 41092 Seville

In this abstract we investigate the effect of fluorine contained molecules in power generation in drop energy harvesting systems. We introduce the concept of a device for energy harvesting from rainfalls. Then, a low cost and high yield chemical vapor deposition technique is introduced that can functionalize a large area with fluorinated molecules. Furthermore, the effect of functionalized fluorinated surfaces is evaluated in energy production. Results of characterization between functionalized and not- functionalized drop energy harvesters are presented and compared. The initial results show that fluorinated surfaces have the ability to store high density of electrical charges and can generate an electret layer with few nanometers of thickness. Respectively, output power and voltage are two orders and one order of magnitude higher in energy harvesters activated by fluorinated molecules. Experimental results show a promising implementation for energy harvesting from rainfalls and water flows.

Biography

Dr. Ali Ghaffarinejad is a postdoctoral researcher at Institute of Material Science at Seville (ICMSE), which is part of the Spanish National Research Council (CSIC), working on hybrid Nanogenerators and drop energy harvesting. He received his B.Sc. degree in Electronic Engineering and M.Sc. degree in Bioelectronics from Iran University of Science and Technology (IUST). He completed his doctoral studies in November 2019 earning the grade “Excellent” for the thesis. His research interests are design, modeling, fabrication, and characterization of Triboelectric, Piezoelectric and Hybrid nanogenerators and their power management circuits.

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Algae based wastewater treatment, value added products recovery and sunlight integration in wastewater treatment

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Many algal species were observed in a waste stabilization pond treating municipal wastewater. However, depending on the stress conditions, culture media, flowing vs. stagnant conditions affect the species proliferation. Some of these algal species showed positive or negative phototaxis depending on the color of the light. Later, three strains of Chlorella Sorokiniana were isolated from the water sample collected from the waste stabilization pond. Two of these strains were used for tertiary treatment of wastewater. It was observed that under different light-dark regime one of these strains showed excellent N and P removal; however, low BOD and COD removal. The sludge addition improved the BOD and COD removal but drastically reduced the nitrogen removal.

The microalgal strain showed an enhanced pathogen removal capacity (1 – 6 log unit removal). These isolated strains were also used to check their ability to produce value-added products in the form of lipid and carbohydrates. For this purpose, hydrolysate produced using water hyacinth was used. These strains showed high biomass productivity with a moderate accumulation of lipids (~ 10 – 13%) and carbohydrates (12%). The fatty acid methyl ester profile of the produced lipids was estimated for both the strains. Kinetic modeling of the lipid profile revealed that the production rate of fatty acids and their various constituents were species-dependent under identical conditions. For value-added products recovery from algae or its uses in wastewater treatment require sunlight. A particular intensity was required for optimum algal growth and wastewater treatment. However, in the natural environment, sunlight intensity varied all over the day. A part of the solar radiation was used for photosynthesis. In this study, a model was developed which was used to find the economic viability of the algae-based wastewater treatment using solar light harvesting. Excess sunlight was used for heat production. It was observed that in some parts in India and Nigeria, this type of treatment system is economically viable can make a profit.

Biography

Dr. Raja Chowdhury currently holds an Associate Professor position in the Dept of Civil Engineering at the Indian Institute of Technology, Roorkee, India. After joining IITR, he has been engaged in developing an algae-based wastewater treatment process that can be employed in the field of wastewater treatment. For this purpose, he used experimental and mathematical modeling techniques. He also has extensive experience in LCA-based sustainability assessment of bioenergy.

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New solutions for storing and using surplus electricity in Methanol

Edgar Harzfeld

Stralsund University of Applied Sciences

The decline of fossil fuels requires the expansion of renewable energy production. The use of wind and pv energy is associated with strong fluctuations that are insufficiently adapted to the demand. The use of storage systems can help to reduce the mismatch. While short-term storage systems such as batteries rely on charging and discharging cycles, long-term storage systems such as methanol storage can be charged and discharged over any time range. Current studies show a wide variety of possible applications for long-term storage systems based on methanol. Methanol can contribute to the decentralized supply of electricity, heat and fuel as well as to grid stabilization. In an emergency case, it can even supply entire consumer clusters autonomously for several days.

Biography

Edgar Harzfeld, Professor at Stralsund University. Studies and research in Leipzig and Zurich. Since 1996 at the Faculty of Electrical Engineering and Computer Science of Stralsund University responsible for electrical power supply and renewable energy systems. Since 2004 - 2022 numerous research projects on the subject of electrical energy storage technologies.

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The role of biofuels as a solution against cavitation in combustion engine injectors

Ludovic Lamoot, Brady Manescau, Khaled Chetehouna and **Nicolas Gascoin**

INSA Centre Val de Loire campus de Bourges 88 Bd lahitolle, University of Orléans, PRISME EA 4229, F-18022 Bourges, France

The objective of this publication is to highlight the role of biofuel as an alternative to conventional fuel in order to combat the effects of cavitation in combustion engine injectors. To do this, an experimental device has been developed. This consists on the one hand of a cold device equipped with a transparent injector and on the other hand of a hot device represented by a NEXGEN burner. In this work, only cold results will be represented. Using the instrumentation set up on the cold bench, it was possible to measure the pressure variation between the inlet and outlet of the injector, the flow rate, the temperature of the fluid. In addition, a visualization system made it possible to highlight the gas cloud associated with a level of cavitation through a fast camera and a strobe. A parametric study based on the type of injector showed that the level of cavitation increased as a function of flow rate depending on the given injector. As a result, different biofuel mixtures with conventional fuel were used. The latter showed that the level of cavitation decreases according to the level of viscosity of the biofuel mixture. The biofuel blend considered optimal also had advantages on the combustion efficiency through low greenhouse gas emissions as well as better higher flux and temperature.

Biography

Engineer in scientific instrumentation since 2003 at the INSA Centre Val de Loire in Bourges campus, I am currently a third-year PhD student at INSA Centre Val de Loire, my thesis topic is entitled “Experimental study of the effect of cavitation on the efficiency of the combustion reaction of a premixed turbulent flame: role of a biofuel as a solution against cavitation.

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Discovery of novel materials for solar driven thermochemical hydrogen

Alicia Bayon

Heterogeneous Catalysis Group (ICP-CSIC, Spain)

Solar thermal-driven thermochemical H_2O and CO_2 splitting offers a carbon-neutral path to produce feedstocks for synthetic fuel production such as hydrogen or synthesis gas. This paper assesses research outcomes for perovskite materials in two-step thermochemical cycles. This presentation will give an overview of the processes with a critical view and recent advances towards commercialization in this field. In addition, a fast method for the classification of effective thermochemical properties (oxygen vacancy formation enthalpy and entropy) in a wide range of operational temperatures is provided. These properties together with a high-grade of sintering resistance and fast kinetics are the main characteristics required to maximize the solar-to-fuel efficiency of the process. The discovery of optimum material compositions for this application could be effectively achieved by a combination of machine learning, DFT, experimental testing and system modelling.

Biography

Dr. Alicia Bayon is Research Scientist at ICP-CSIC since 2022 working on discovery of novel redox active materials for solar hydrogen production. Before that she completed her PhD at IMDEA Energy (Madrid, Spain) in 2014. From 2014 to 2020 she worked at CSIRO Energy (Newcastle, Australia) as Postdoctoral Fellow followed by an appointment at Arizona State University (USA) as a Research Scientist (2020 to 2022). She joined ICP-CSIC via the prestigious Talent Attraction Program of Spain. She has been working in 8 international research projects and consortiums, 2 of them with companies. She has attracted more than USD 5 million in funding. She is author of 32 research articles and more than 40 conference presentations (7 times as invited speaker).

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β-glucosidase produced by Moniliophthora perniciosa: characterization, immobilization and application in the hydrolysis of sugarcane bagasse

Sandra Aparecida de Assis, Larissa Emanuelle da Silva Almeida and **Geise Camila Araújo Ribeiro**

Enzymology and Fermentation Technology Laboratory, Health Department, State University of Feira de Santana, Feira de Santana, Bahia, Brazil

The use of lignocellulosic materials to obtain second generation ethanol using enzymatic catalysts has as main limiting factor the high cost of enzymes. β-glucosidases (BGLs) belong to the group of enzymes of cellulases and acts in the last stage of cellulose degradation, releasing glucose molecules, eliminating the inhibitory effect of cellobiose. This study focused on the production, characterization, immobilization and application of β-glucosidase from Moniliophthora perniciosa in the hydrolysis of pre-treated sugarcane bagasse, with varying enzymatic loads and reaction times. The enzymatic extract obtained from the submerged fermentation of the filamentous fungus Moniliophthora perniciosa was immobilized in calcium alginate spheres by the direct trapping method. The enzyme showed an optimum pH of 4.5 and 60°C. It was stable at all temperatures analyzed (50–90°C) and retained about 100% of its activity at 50°C after 60 min of incubation. Among the ions analyzed, BaCl2 increased BGL activity 9.04 ± 1.41 times. The maximum production of reducing sugars (89.15%) was achieved after 48 h with 10 mg of protein. Percentage of reducing sugars reached after 48 h of hydrolysis with the enzymatic extract supplemented with the immobilized enzyme was 226%, 2 times higher than the value found using only the free enzymatic extract. The immobilized enzyme preserved 50% of its initial activity after 1 h at 80 °C and exhibited higher activity at pH 6 to 60 °C. The results obtained in the present work are very promising because it is a simple technique of low cost and with potential application.

Biography

Graduated in Biochemistry Pharmacy from the State University of São Paulo Júlio de Mesquita Filho (1998). Doctorate in Biotechnology from the State University of São Paulo Júlio de Mesquita Filho (2004). She is currently Full Professor at the State University of Feira de Santana and coordinator of the Laboratory of Enzymology and Fermentation Technology. Member of the Brazilian Chemical Society (SBQ). Founding Member of the Biotechnology Symposium (SiBiotec) of PPGBiotec-UEFS. Develops research in the areas of Applied Enzymology and Macromolecule Chemistry. His main research line is Obtaining products of industrial interest from plants or microorganisms. She is currently coordinator of the Graduate Program in Biotechnology (PPGBiotec) of the State University of Feira de Santana, Bahia.

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Alkaline pretreatment of lignocellulosic biomass for hollocellulose and xylan extraction

Luciana Lehuedé, Constanza Henriquez and **Oriana Zalazar**

Centre for Biotechnology and Bioengineering, Department of Chemical Engineering, Biotechnology and Materials, University of Chile, Beauchef 851, Santiago, Chile.

Looking to a sustainable bio-based economy, in the past few years, the co-production of bioethanol and value-added products from renewable lignocellulosic biomass, such as xylooligosaccharides, has gained relevance. However, one of the major drawbacks of this technology is the lignocellulosic biomass pretreatment. This stage, which aims to break lignin-carbohydrate complexes making the carbohydrates accessible to enzymes, is still a technology in development given the low yields obtained, especially when hardwoods are employed as an LCB source. In this context, alkaline/thermal pretreatment has proved to be an efficient process for delignification, while alkaline/thermal pretreatment followed by ethanol precipitation has been indicated as the best strategy for xylan extraction; however, the heterogeneity of protocols and evaluation parameters observed in the literature hinder the selection of appropriate operational conditions. Therefore, in this study hollocellulose and xylan extraction from five different types of Nothofagu gender trees (Nothofagus obliqua, Nothofagus pumilio, Nothofagus Dombey, Nothofagus Alpina and Eucalyptus globulus) were evaluated through different alkaline-thermal extraction conditions. Results indicate that higher holocellulose recovery yields are obtained when N. dombey is pretreated at 12% NaOH concentration, while higher xylan recovery yields are obtained when N. pumilio is pretreat at 12% NaOH concentration and precipitated with ethanol.

Biography

Biochemical Engineer with a PhD in Engineering Sciences with biochemical engineering mention. Currently I´m a Postdoctoral Researcher at Centre for Biotechnology and Bioengineering (CeBiB) (University of Chile). My goal is to contribute to sustainable development by creating green processes for the industry using enzymes as a catalyst and industrial waste as substrates.

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Perspectives of the continuous use of fossil fuels and their impact on the society

Ernesto A. Chavez

CICIMAR, IPN, Mexico

At the current level of global warming, climate change impacts on ecosystems and human societies, demand urgent action to mitigate their effects by reducing the emmision of CO2 and to limit warming to 1.5°C. Otherwise, the society and natural systems would have to pay the consecquences in terms of extreme loss of biodiversity, health costs and a significant increase of mortality of human beings. Attributable warming due to human societies is about equal to the global increase to 1.1oC relative to the 1850 – 1900 average. This has no precedent for the last 2000 years. The main causes of this increase in global temperature have been identified as being the effect of releasing carbon dioxide, methane, nitrous oxide and other greenhouse gases by human activities. Sources of greenhouse gas emissions (GHG) in % are as follows, Energy sector 33; Industry 24; Agriculture and related activities, 22; Transport15; Buildings 6. Due to past emissions of (GHG), many changes in the biosphere are will take centuries to restore, because they have surpassed the limits of resilience of some natural systems. CO2 concentrations are nowadays higher than any time in the last two million years. Methane and nitrous oxide are nowadays higher than any time in the last 800,000 years. Global net antropogenic GHG emissions were 60 GtCO2-eq in 2019 (12 % higher than in 2010 and 54 % higher than in 1990). In conclusion, past and current climate risks provide a basis for actions addressed to mitigation and risk management actions, so the society may be able to develop warning systems and strategies to reduce emmisions addessed to achieve a better world in a context of sustainable development.

Biography

Ernesto A. Chávez y Ortiz. Biologist and Ph D. He is specialized in fisheries stock assessment. fisheries simulation, and in the coral reef ecology. He has published 175 scientific papers and edited two books. He is professor of the M. Sc. and Ph. D. in Marine Science programs at the Interdisciplinary Center of Marine Sciences of the Polytechnic Institute of Mexico, where has been advicer of sixteen M. Sc. Students and eight Ph. D.

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Life cycle assessment of lactic acid production: Comparison between from unexploited lignocellulosic biomass and non-renewable resources

Rita Pontes[1], Aloia Romaní[2], Michele Michelin[2], Lucília Domingues[2], José Teixeira[2], António Veríssimo[3] and **João Nunes[1]**

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[2]CEB-Centre of Biological Engineering, University of Minho, Campus Gualtar, 4710-057 Braga, Portugal
[3]CNC- Center for Neuroscience and Cell Biology, University of Coimbra, 3004-504 Coimbra

Lactic acid (LA) demand is expected to increase due to new processing technologies and further several fields of application. The lactic acid production from unexploited lignocellulosic biomass was compared with the lactic acid production from non-renewable resources and it was modeled using the Life Cycle Assessment method through SimaPro®. The life cycle approach took into account the raw material, transport, pretreatment, saccharification and fermentation and LA recovery considering 1 tonne of LA as the functional unit. The life cycle inventory of the biobased LA was obtained from lab-scale experiments while the fossil-based LA was obtained from the ecoinvent database of SimaPro®. The major environmental savings obtained by replacing one tonne of fossil-based LA by biobased LA are : 4056.60 kg CO2 eq. of global warming potential; 193.03 kBq U235 eq. of ionizing radiation potential; 3.78 kg C2H4 eq. of photochemical oxidation potential; 0.73 kg PO4 3- eq. freshwater eutrophication potential; 9569.40 kg 1,4-DB eq. of terrestrial ecotoxicity potential; 99.32 kg 1,4-DB eq. of fresh water aquatic ecotoxicity potential; 137.69 kg 1,4-DB eq. of marine aquatic ecotoxicity potential; 94.89 human toxicity potential and 126.63 m2 of land use. Auxiliary chemicals, electricity and enzyme used in the biobased LA production are most relevant to the total environmental impacts. Thus, biobased LA production significantly reduces the impact on the environment of LA production, giving 60 % environmental savings compared to fossil-derived LA.

Biography

Ana Rita Pontes Pereira, Chief Research Officer and board member at BLC3 - Campus of Technology and Innovation. She is doctorated in Biosciences, with specialization in Biotechnology (biorefineries), in business scope by FCT in BLC3 with a partnership of the University of Minho and University of Coimbra. Master's degree in Biological Engineering with specialization in Environmental Technologies, at the Minho University.

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