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Role of Bioenergy in Achieving Sustainability

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Abstract

Sustainability shares its root with sustenance. Our society is sustained by energy use, which it derives from many sources: oil, coal, natural gas, hydroelectric, nuclear, wind, solar, and biomass. Annual consumption of global energy is equivalent to 4 cubic miles of oil (cmo), about 3 of which are obtained from fossil sources: oil, coal, and natural gas. The dominance of fossil energy in the global mix has been longstanding—ever since the dawn of the industrial revolution in the mid nineteenth century. As a result, the concentration of carbon dioxide in the atmosphere has increased from 280 ppm to over 400 ppm and continues to rise. CO_2 is a greenhouse gas and it and now threatens life as we know it from the resulting climate change. To avert devastation from climate change or constrained energy supply, the world desperately needs sources of clean, carbon-free energy that together can scale to cmo levels. Much emphasis has been placed in recent years on resources like wind and solar to provide clean electricity. Technological advances have led to dramatic reductions in their costs and their advocates now propose a future powered entirely by them. However, these costs do not include the cost of storage, currently provided by natural gas, nor do they consider the environmental cost of mining for the materials needed for their installation. Scaling to a 100%-renewables scenario will strain the global supply of commodities like steel, concrete, glass, and aluminum; clearly not a sustainable scenario.

Burning biomass has been proposed as a fuel source; indeed, prior to the industrial revolution the world once derived 100% of its energy from bio sources. Unlike wind and solar, bioenergy sources are storable and do not suffer from intermittency. However, biomass use also results in emitting CO_2. The only reason these emissions are not counted is that the regrowth of the biomass would take an equivalent amount of CO_2 out of the air. For this assumption to hold, it is important that we consider harvesting only rapidly growing biomass or annual crops.

Global biomass production is substantial; it is estimated that 75 Gt (gigatons, or 10^9 tons) of biomass are produced annually. Most of the biomass is in the forests and oceans and not readily recoverable, nor is it desirable to cut down this “sequestered” carbon and burn it. The estimate for recoverable biomass resource is only 3 Gt/y. At a heating value of 15 GJ/t (gigajoules/ton) the energy from these 3 Gt of biomass would correspond to only 0.3 cmo. Clearly, not enough but a significant contributor. Sustainably produced biofuels could also fuel aviation, which cannot be powered by electricity. Sustainability demands a scalable source of clean and cheap electricity. Nuclear power can deliver that. It has the smallest environmental footprint and the best safety record, but public concerns over plant safety, long-term storage of waste, and cost are considerable obstacles. Getting the public to embrace nuclear power is a Herculean task, but it must be undertaken. We have to (i) educate the public (ii) stop closing functional nuclear power plants; (iii) expand the fleet of nuclear power plants; and (iv) develop and deploy the next generation of walk-away safe plants that can also use the spent fuel as a resource.

Biography

Ripudaman Malhotra, PhD, is an organic chemist, and during his 36-year tenure at SRI worked extensively on the chemistry of processing fossil fuels. In 2005 he joined Hew Crane and Ed Kinderman to co-author *“A Cubic Mile of Oil: The Looming Energy Crisis and Options for Averting It,”* which was published by the Oxford University press in 2010. Among his technical works are over 100 papers in archival literature. He is a section editor of *Encyclopedia of Sustainable Science and Technology.* In 2005 he was named an SRI Fellow, in 2015 he was awarded the Storch Award for Fuel Sciences by the Energy and Fuel Division of the American Chemical Society (ACS), in 2018 he was named an ACS Fellow, and in 2019 he was inducted into the SRI Hall of Fame.

Bioelectricity Generation from House plant and Vegetable Plants

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Abstract

Bioelectricity generation from living plants through Microbial Fuel Cell (MFC) is an alternate way to get bioenergy. However, this technology is mainly focus on the aquatic plants. In this research, we tried different house plants and non-aquatic vegetable plants for bioelectricity generation through MFC. A 5 L plastic pot with bamboo charcoal as electrode materials used to prepare the plant microbial fuel cell. Four different types of house plants were used, and two vegetable plants were used for this experiment. It was found that among the four house plants, the umbrella plants showed the best result in terms of voltage generation and Taro plants showed the highest voltage between the two vegetable plants. However, the non-aquatic plants can be used to generate bioelectricity by using the house plants and the bioelectricity from vegetable plants can help to get bioenergy and the food at the same time.

Biography

Azizul Moqsud is an Associate Professor, in the department of Civil and Environmental Engineering, Yamaguchi University, Japan. He was the former Visiting Professor in the Department of Civil and Environmental Engineering, University of California Berkeley, USA. He has written more than 120 academic papers and some book chapters. He has been awarded several awards including the Prime Minister Gold Medal and Excellent Presentation Award and Excellent Teacher award.

Chemical Looping Conversion of Lignocellulosic Biomass Main Organic Component

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Abstract

Biomass chemical looping conversion technology (BCLC) can convert biomass with negative carbon emissions. For chemical looping combustion (CLC) process, the main products were CO_2 and H_2O with heat for power generation. Compared to CLC, chemical looping gasification can provide more useful products, such as H_2 and CO, which can be synthesized to other high-value chemicals. Due to the variety of biomass, the results about the products distribution were affected by the organic and inorganic compounds. Thus, it is necessary to explore the conversion behavior of the main compounds in biomass during chemical looping process.The influence of reaction temperature (from 700 °C to 850 °C) and mixing ratio of oxygen carrier (10 wt.%, 30 wt.%, 50 wt.%) on the products distribution and kinetic characteristics were investigated via a fixed-bed reactor. Lignin was selected as one of the primary organic compounds of lignocellulosic biomass. CuO was used as an oxygen carrier. The Gibbs free energy minimization method is used to thermodynamically simulate the factors affecting the chemical looping gasification process of lignin/copper oxide carriers under atmospheric pressure. The simulation can be used to obtain the optimal conditions for the reaction and provide the basis for subsequent experiments. The increase of water vapor can promote the reforming reaction, increase the production of H_2, gas production rate and carbon conversion rate. However, excess water vapor will reduce the efficiency of the gasification system. From the viewpoint of reaction equilibrium and gasification efficiency, the molar ratio of water vapor/lignin can be 1.2-1.5.

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Biography

Zhiqiang Wu is an associate professor in the School of Chemical Engineering at Xi'an Jiaotong University (XJTU). He is also a visiting scholar in the Department of Chemical and Biological Engineering at University of British Columbia (UBC) from 2016 to 2017. He received his Ph. D. (2015) in power engineering and engineering thermophysics, double Bachelor (2009) in engineering and economics from Xi'an Jiaotong University. His work involves the co-thermochemical conversion of coal and biomass, upgrading of low-rank coal and biomass conversion. He has published 40 academic papers and been granted 10 patents. As the Principal Investigator, he got 12 program grants from National Natural Science Foundation of China, Ministry of Science and Technology of China, etc.

Nuclear Power a Sustainable Energy Mix for Combating Global Climate Change

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Abstract

Nuclear power supplied 2,563 terawatt hours (TWh) of electricity in 2018, equivalent to about 10% of global electricity generation, and was the second largest low-carbon power source after hydroelectricity. As of December 2019, there are 443 civilian fission reactors in the world, with a combined electrical capacity of 395 gigawatt (GW). There are also 56 nuclear power reactors under construction and 109 reactors planned, with a combined capacity of 60 GW and 120 GW, respectively. Most reactors under construction are generation III reactors in Asia.

The central aim of the 2015 Paris Agreement is to keep the rise in global temperatures to well below 2 °C compared to pre-industrial levels, and with the aim to limit the rise to 1.5 °C. This is driven by the scientific consensus that limiting the rise to 1.5 °C would significantly reduce the risks posed by climate change.

Concerted international efforts over the past 20 years have increased the amount of electricity generated by wind, solar and other renewable sources, but have failed to displace fossil fuels from the energy mix. As a matter of fact, in 2017, fossil fuels produced more electricity – in relative and absolute terms – than ever before. In its 2018 report, Global Warming of 1.5 °C, the Intergovernmental Panel on Climate Change (IPCC) warned that we are likely to breach the 1.5 °C threshold by as early as 2030.

Nuclear power produces no greenhouse gas emissions during operation, and over the course of its life-cycle, nuclear produces about the same amount of carbon dioxide-equivalent emissions per unit of electricity as wind, and one-third of the emissions per unit of electricity when compared with solar.

The nuclear industry recognizes the scale and immediacy of the challenge, and the important role that all low-carbon energy sources must play to combat climate change. Harmony – the industry's vision for the future of electricity supply – sets a target to build an additional 1000 GWe of nuclear reactors across the world so that nuclear power would provide 25% of electricity by 2050.By achieving Harmony, we can build a new, cleaner and truly sustainable world – enabling us to pass on a cleaner planet to our future generation.

Biography

M A Rashid Sarkar works as Professor in Nuclear Science and Engineering Department of Military Institute of Science and Technology. He has completed Ph.D degree from USSR in 1983 on two phase flow heat transfer in narrow channel. Worked as Professor in Mechanical Engineering Dept Bangladesh University of Engineering & Technology, Dhaka Bangladesh till 2018. He has published more than 100 papers- on energy conservation& efficiency, heat and mass transfer safety of nuclear reactor, instrumentation control in nuclear reactors. He has extensive exposure on research and training on nuclear engineering. Presented papers in various national and international conferences. Published four books. He works on various projects of national and international importance.

TnCel12B, Overexpression and Characterization of a Hyperthermophilic GH12 Endo1,4-Β-Glucanase Cloned from Thermotoga Naphthophila Rku-10T

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Abstract

A putative cellulolytic gene (825 bp) from Thermotoga naphthophila RKU-10T was overexpressed as an active soluble endo-1,4-β-glucanase (TnCel12B), belongs to glycoside hydrolase family 12 (GH12), in a mesophilic expression host. Heterologous expression and engineered bacterial cell mass was improved through specific strategies (induction and cultivation). Hence, intracellular activity of TnCel12B was enhanced in ZYBM9 modified medium (pH 7.0) by 8.38 and 6.25 fold with lactose (200 mM) and IPTG (0.5 mM) induction, respectively; and 6.95 fold was increased in ZYP-5052 auto-inducing medium after 8 h incubation at 26°C (200 rev min-1). Purified TnCel12B with a molecular weight of ~32 kDa, was optimally active at 90°C and pH 6.0; and exhibited prodigious stability over a wide range of temperature (50-85°C) and pH (5.0-9.0) for 8 h. TnCel12B displayed great resistance towards different chemical modulators, though activity was improved by Mg2+, Zn2+, Pb2+ and Ca2+. Purified TnCel12B had affinity with various substrates but peak activity was observed toward barley β-glucan (1664 U mg-1) and carboxymethyl cellulose (736 U mg-1). The values of Km, Vmax, kcat, and kcat Km-1 were found to be 4.63 mg mL-1, 916 µmol mg-1min-1, 1326.7 s-1 and 286.54 mL mg-1 s-1, respectively using CMC substrate. All noteworthy features of TnCel12B make it an appropriate industrial candidate for bioethanol production and various other potential applications.

Biography

Ikram-ul-Haq (SI) has completed his Postdoc from Cornell University, New York, USA, and Ph.D. in Industrial Microbiology from University of the Punjab, Lahore, Pakistan. He has been the Dean, Faculty of Science and Technology and founding Director of Institute of Industrial Biotechnology, Government College University (GCU), Lahore. He has successfully completed 19 Projects sponsored by Pakistan Science Foundation, Pakistan Atomic Energy Commission, HEC, GCU & Ministry of Science and Technology while 2 Projects are in process sponsored by MoST, PSF and Pakistan Academy of Sciences. He has published more than 370 papers in journals of international repute, with 3708 citations and has been serving as an editorial board member of reputed Journals.

Increasing Plastic Wastes and Affecting Energy Policy Due to Covid-19 Outbreak Effects: Bio-Energy Product

Tolga Taner

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Abstract

This study includes waste and energy policies and emphasizes the effects of Covid-19 epidemic as well as bio-energy production. The Covid19 epidemic has caused and continues to be devastated all over the world, and the economies of the countries are shattered and have an impact on all energy policies. Although energy policy changes cause huge economic shocks, it has not yet hit its full blow. It is assumed that the Covid19 epidemic may continue, and it is also mentioned that there may be 2, 3 or more epidemic waves. The probability of these epidemic waves seems to be very worrying. It is predicted that it will not only cause deaths spiritually, but also shake the economies of the country. It is also obvious that countries will have a heavy impact on their energy policies. With this epidemic, plastics and their derivatives are seen to be very prominent. The wastes are incredibly shocking because of the fact that the rate of use in plastic bags (due to their infectious effect) as well as protective gloves and protective gowns and masks worn by healthcare workers for protection and health, this is expected to have an impact on human health. Therefore, the economies of the country urgently need to utilize these wastes as bio-energy and should be included in the energy policies of the countries as an emergency action plan. The aim of this study is to reveal that the effects of increasing plastic waste due to Covid19 epidemic can be eliminated by using it as bio fuel. Apart from that, it is emphasized that energy policies are revised according to the Covid19 epidemic.

Biography

Tolga Taner is the Head of the Department of Motor Vehicles and Transportation Technologies at the Aksaray University since 2012. After completing his BSc degree from Mechanical Engineering, Pamukkale University in 1998 and MSc degree in 2002, he graduated from Gazi University Mechanical Engineering PhD in 2013. He worked as a part-time lecturer at METU University in 2003-2006. He teaches graduate courses and educates students in Energy and Nanotechnology fields. His research includes energy-renewable energy. He has published many scientific articles, conference papers and books. In addition to his book editorships and authors, he is a part of international SCI, ESCI indexed journals as well as editor and reviewer.

Multi-Stage Gasification of Wood Biomass: Experimental Study

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Abstract

One-stage gasification processes were widely developed and researched during the 20 century both in Russia and foreign countries. They still stay as main processes in modern gasifiers design. In a number of previous projects authors investigated solid fuel conversion technologies using technical and economic methodology with physical and computational experiments. These researches showed that one-stage processes have achieved the limits of performance, so it is impossible to enhance qualitatively their efficiency.

To fit modern technics development level, gasification technologies are to match following criteria: a) to allow automatic (mainly unmanned) work regimes; b) to provide stable (with insignificant deviations) gas composition and mass flow; c) to produce minimal liquid and solid wastes; d) to be insensitive to fuel characteristics such as moisture content and particles size; e) to provide cold gas efficiency at level of 80-85%.

The article is devoted to the choice and justification of the directions of technology development for the effective use of wood waste through their thermochemical conversion, as well as the development of a competitive automated installation multistage gasification of wood biomass.

Biography

Alexander Kozlov, Ph.D., is a specialist in the field of thermochemical conversion of solid fuels. He took part in writing more than 70 scientific papers. Since 2012, he is a member of the International Confederation for Thermal Analysis and Calorimetry. In 2013-15, he was a laureate of the Scholarship of the President of the Russian Federation. Currently, he is the leader of the Russian group within the framework of the BRICS project (Thermochemical conversions of lignocellulosic biomass/wastes into bioenergy and biofuels and its utilization in internal combustion engine), in the implementation of which scientists from 5 countries participate.

Effect of Particle Sizes on Biogas Generation from Sugarcane Bagasse and Corn Silage with South African Wastewater

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Abstract

In this study, the effects of particle size on sugarcane bagasse (SCB) and corn silage (CS) with South African industrial wastewater for biogas production were investigated at a mesophilic temperature of 35 °C. Biogas, a renewable source of energy could serve as an alternative means to replace the use of non-renewables such as coal in South Africa. It has been found that the speed and stability of the anaerobic digestion process depends mainly on the particle size of the input material. Variations in particle sizes for both SCB and CS were observed at 2 mm, 1 mm, 0.6 mm and 0.4 mm whiles the hydraulic retention time, the biomass loading rate and the pH of the biodigesters were monitored at 20 days, 0.5 gVS/100 mL and 6.5 - 8.0. Highest biogas yield was obtained from CS at a particle size of 0.4 mm with anaerobic biodigesters controlled in batch mode. The result showed that smaller particle size distribution favors the biogas production of CS compared to SCB.

Biography

Edward Kwaku Armah is an Environmental Chemist and working towards to be a Chemical Engineer soon. He obtained both BSc and MPhil degrees in Chemistry and Environmental Chemistry respectively (KNUST-Ghana) and currently finishing up his Doctor of Engineering degree in Chemical Engineering. His research areas focus on Water and Wastewater Treatment Technologies, Biomass Valorization into value added products and Waste Management. He has co-supervised 6 undergraduates in the Department, serving currently as an assistant lecturer for the Environmental Sustainability Module and adds to his credit, over 10 published peer reviewed research articles.

Extracting and Harvesting Energy from a Biological Cell

L. Catacuzzeno*, L. Sforna, A. Di Michele, F. Cottone, S. Chiappalupi, G. Sorci, F. Franciolini and L. Gammaitoni

Università di Perugia, Italy

Abstract

This work shows how electrical energy can be harvested directly from the membrane potential of biological cells and used to power a wireless communication. Experiments were first performed by exploiting the membrane potential of large Xenopus oocytes from female frogs (Catacuzzeno et al. 2019). The electrical potential energy harvested from Xenopus oocytes membrane was first transferred to a capacitor connected to the cell via a proper electrical circuit, and then used to power a radio frequency communication that carries bio-sensed information to a distant receiving circuit. A similar amount of energy could also be extracted from skeletal myotubes obtained from murine C2C12 myoblasts, suggesting that mammalian cells can be used as well. Our results show that electrical energy can be harvested directly from biological cells and used for a number of purposes, including wireless communication of sensed biological quantities to a remote receiving hub, or the design of auto-rechargeable biological batteries.

Biography

Luigi Catacuzzeno, PhD, is an electrophysiologist working as an Associate Professor at the University of Perugia, Italy. His research activity has been focused on the study of ion channel structure-function relationship and on the electrical behavior of biological cells, using both experimental and theoretical approaches. Among his scientific works are over 60 peer reviewed papers in international journals. He is an associate editor of the European Journal of Physiology and a reviewer editor of Frontiers in Cellular Physiology. In 2015 he was involved in a project aimed at harvesting electrical energy from the resting potential of biological cells in collaboration with Prof Gammaitoni.

Ascertaining Optimum Pyrolysis Conditions for Biochar Production from Maple Sawdust

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Abstract

Sawdust is a waste product from wood processing industries. In the recent time, pyrolysis of organic waste is an emerging technology where biochar can be produced and used for carbon sequestration. In that respect, the aim of the present work was to ascertaining optimum pyrolysis conditions in producing sawdust biochar (SBC) for the said uses. The raw material was collected from Belad furniture industry because of their specialization in furniture work and large volume of sawdust availability. The proximate and ultimate analysis of 3.56% moisture, 1.49% ash content, 72.32 carbon and 0.19% surphur confirmed its good candidature for biochar production. The pyrolysis experiment was carried out by using six combination each of temperature (400, 450, 500, 550, 600 and 650 oC), nitrogen flow rates (0.5, 1.0, 1.5, 2.0, 2.5 and 3.0L/mins) and residence times (10, 20, 30, 40, 50 and 60mins). Analysis of resulted biochar was done according to IBI standard. Results showed that the three factors decrease the yield of biochar at their increasing values. SBC yield was optimum at temperature of 400 oC, 10min residence time and 1.0L/min nitrogen flow rate.

Biography

Bello Alhassan is a lecturer in Entrepreneurship Development Centre, Kwara State Polytechnic, Ilorin. He had second class upper during his first degree in chemical engineering from Federal University of Technology, Minna and subsequently obtained master's degree in chemical engineering in 2016. He is currently undergoing doctorate degree from the same University. He specialized in Carbon Capture and Storage with interest in biochar.