



7th INTERNATIONAL WORKSHOP ADVANCES IN CLEANER PRODUCTION

“CLEANER PRODUCTION FOR ACHIEVING
THE SUSTAINABLE DEVELOPMENT GOALS”

Advances in Cleaner Production CONFERENCE PROCEEDINGS

Barranquilla, Colombia - June 21st-22nd - 2018

Universidad de la Costa



In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.*

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Special thanks are addressed to Dr. Yugo Okida, the Vice-Rector of Post Graduation and Research of Universidade Paulista, Dr. Marília Ancona-Lopez, the Vice-Rector of Graduation of Universidade Paulista, and to Dr. Marina Soligo, Main Coordinator of Post Graduation and Research of Universidade Paulista, for their unconditional support.

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.*

Message of Welcome

On behalf of the Organizing Committee, we have the honor to welcome for this opportunity to all participants, and to express my greatest wishes that the event will serve to establish fruitful collaborations among participants.

The extensive program, the representative number of participants, the quality of the conferences and contributions allows this event to be considered the most important event held in Colombia addressing Cleaner Production. It is the consequence of contributions from several colleagues scattered in different parts of Latin America and of the World. Colleagues who are working for several years in different types of institutions: academic, business and government.

You are responsible for the size and quality of the **International Workshop on Advances in Cleaner Production**. The impact will largely depend on the interaction and discussion that will occur among you, encouraged by the organization of this event.

Welcome!

Bienvenidos!

Bem-Vindos!

We wish a fruitful participation, a pleasant stay, and that you have a good return to your home institutions. We hope also that you continue contributing to the Advance of Cleaner Production and Sustainable Development.

General Chair and Founder

Biagio F. Giannetti – Paulista University (UNIP) - Brazil

Directive Committee

Juan José Cabello Eras - Conference Chair - Universidad de La Costa
- Colombia

Zhifeng Yang – Conference Co-Chair - Beijing Normal University -
China

Presentation

The "**International Workshop on Advances in Cleaner Production**" is a multi/interdisciplinary forum for the exchange of information and research results on technologies, concepts and policies based on Cleaner Production and conceived to assist the desired transition to a sustainable society.

Cleaner Production is a concept that goes far beyond the simple pollution control. It includes research and development of new processes, materials and products directed to promote the efficient use of resources and energy. Prevention must be the first approach of governments and corporations concerning sustainable development, and for this, environmental friendly strategies allied to economical robustness of products and services must be assured.

The adoption of Cleaner Production by governments, companies, and universities is getting speed with technical assistance and training programs, but it is worthy of attention that all these initiatives, even if implemented by all governments and corporations, do not guarantee the achievement of sustainable development. There is still a lack of a science, and consequently of a consolidated engineering devoted to the sustainable development.

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Objectives

The "7th International Workshop on Advances in Cleaner Production" is an international forum to be held in June 21st and 22nd, 2018 in Barranquilla, Colombia. The "7th International Workshop: Advances in Cleaner Production" aims to promote:

- 1.** The exchange of academic information;
- 2.** The presentation of recent achievements;
- 3.** The discussion of common problems and their possible solutions;
- 4.** The contact among academic knowledge and corporate experiences;
- 5.** The discussion of the event's theme **"Cleaner Production for Achieving the Sustainable Development Goals"**.

Researchers interested in Cleaner Production and Sustainable Development are invited to submit papers. Authors devoted to correlated themes are also welcome

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Program

Time	June 21st, 2018 (Thursday)	June 22nd, 2018 (Friday)
08:00 to 09:40	Reception	Oral Presentations (6A)
09:40 to 10:00	Opening Ceremony	Break
10:00 to 10:30		Workshops
10:30 to 12:00		Room 01: Responsible Consumption and Production Room 02: Climate Action and Affordable Clean Energy Room 03: Sustainable Cities and Communities Room 04: Industry Innovation and Infrastructure
10:30 to 12:00	Opening Conference (*) Paul Sutton University of Denver - USA (*)In partnership with Inno4sd.net and TNO	
12:00 to 13:30	Lunch	Lunch

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Program

Time	June 21st, 2018 (Thursday)	June 22nd, 2018 (Friday)
13:30 to 15:00	Conference Luca Coscieme Trinity College Dublin Ireland	Special Conference ACPN Medal Award Young Researcher Gengyuan Liu Beijing Normal University China
15:00 to 16:30	Oral Presentations (5B)	Oral Presentations (6B)
16:30 to 16:50	Coffee break	Coffee break
16:50 to 18:50	Plenary Presentations Carlos Poveda Netherlands Organisation for Applied Scientific Research (TNO) Chantal Block 2C Ecosolutions Samira Garcia Freites University of Manchester Soraya El-Deir Federal Rural University of Pernambuco	Special Conference ACPN Medal Award Senior Researcher Carlo Vandecasteele University of Leuven Belgium
18:50 to 19:50		Special Mention Award, Closing Ceremony and Cocktail

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.

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“CLEANER PRODUCTION FOR ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS”

Barranquilla – Colombia – June 21st - 22nd - 2018

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.

Conferences and Oral Presentations 21st June 2018

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.

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“CLEANER PRODUCTION FOR ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS”

Barranquilla – Colombia – June 21st - 22nd - 2018

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21st June 2018

10h30-12h00**Opening Conference**

Paul Sutton

University of Denver - USA

"Do the Limits to Growth Apply
to Smart Cities that Have
Achieved the Sustainable
Development Goals?"

Do the Limits to Growth Apply to Smart Cities that Have Achieved the Sustainable Development Goals?

Paul Sutton
University of Denver - USA

The year 2022 will mark the 50 year anniversary of the much maligned and controversial 'Limits to Growth' study which asserted that economic growth and population growth cannot continue indefinitely. Since then the world has seen major declarations and aspirations relevant to the limits to growth including: 1) The 1987 WCED (Brundtland Report coining the phrase 'sustainable development'), 2) The 1992 UNCED (the Rio Declaration establishing Agenda 21, the UNFCCC, CBD, and UNCCD, 3) The 2005 Millenium Ecosystem Assessment, and 4) the 2015 Sustainable Development Goals. A nascent 'Smart City' movement is purporting that information technology and webs of sensors will enable the perhaps contradictory goal of 'Smart Growth'. This presentation explores the challenge of achieving 'sustainable cities and communities' with 'no poverty', 'clean water', 'clean energy' and the many other sustainable development goals through the lens of 'Limits to Growth'. The city of Shanghai in China has determined that it hopes to cap it's total population at 25 million people. Here, we will contemplate the questions: Can a city become too big? Will smart cities know when they have become too big? Is the smart city movement avoiding the unpleasant limits to growth question and merely enabling the building of larger and larger cities that are even more vulnerable to exogenous shocks to their systems?

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21st June 2018

13h30 -15h00	Conference
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Luca Coscieme

**Trinity College Dublin –
Ireland**

The Paradoxes and Delusions of
Economics

The Paradoxes and Delusions of Economics

Luca Coscieme
Trinity College Dublin - Ireland

Orthodox economics has seen many of its theoretical pillars undermined by the emergence of “paradoxes” and “delusions”. Despite this, unresolved debates and blind faith have protected the discipline’s status-quo, fostering unsustainable environmental, social, and economic policies. The Sustainable Development Goals could be achieved only through not focusing anymore on economic growth at all costs, but instead promoting wellbeing economies. We present an organic and chronological discussion of some paradoxes and delusions of economics, surrounding efficiency and resource use; wealth and wellbeing; economic growth; and the distribution of wealth between rich and poor nations. We highlight the need to reform mainstream economics and its unquestioned status as the primary academic discipline for informing national and international policy and achieving the Sustainable Development Goals.

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21st June 2018

15h00-16h30	Session 5B	Room 1
Implementing the SDG15: Business Climate Index in the Context of the Forestry Sector of Tocantins, Brazil		
Energy Audits: Ecological Sustainable Research Center		
Clean Energy or Coal, Jobs and Displaced Carbon Emissions at Any Cost? Assessing Australia's Brown Coal v. Solar-Produced Liquid Hydrogen Exports to Japan		
Cleaner production to adapt to climate change: A stakeholder Delphi survey in a heavily affected district in Vietnam		

Implementing the SDG15: Business Climate Index in the Context of the Forestry Sector of Tocantins, Brazil

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Abstract

The forestry sector, is one of the key sectors indicated in the SDGS, with a specific SDG Goal 15, and crucial for Brazil. This paper aims to contribute to the discussion of the role government needs to play in shaping the business environment to foster the achievement of the SDGs by investigating how can business climate indexes be used to shape public policy. In order to do that, the Forest Investment Attractiveness Index (FIAI) has been applied to the state of Tocantins, in Brazil, to further comprehend which areas of public policy intervention would be more relevant to support the development of a sustainable forestry sector. The results indicate that the sort of tool can only be used in a preliminary analyzes of the economic, political and institutional environment related to the forestry sector.

Keywords: *forest resource policy, forest investment, investment climate.*

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Energy Audits: Ecological Sustainable Research Center

VELAZQUEZ, L.E. ^{a*}, MUNGUÍA, N. E. ^a, HERRERA,
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Abstract

The purpose of this paper is to present the obstacles to carry out the conduction of an Energy Audit in the Ecological Center of the State of Sonora with the final purpose of increasing the energy efficiency in its facilities. It is called Energy Efficiency (EE) when a reduction is achieved in the amount of electric power and fuels that are used without affecting quality (ACEE, 2017); to achieve EE, it is necessary to promote actions where technological innovation projects are linked (Huitron, 2017) because this type of technology leads to the reduction of energy consumption in order to regulate energy intensity (EI) (Factor Energia, 2017). EI is a relevant development factor to achieve an improvement in energy efficiency (World Energy Council, 2010), and this improvement is achieved through the reduction of energy consuming activities, as well as being more efficient in the use of it energy (Mendiluce and Linares, 2010).

Keywords: *Energy Efficiency, Energy Audits, Energy Intensity.*

Clean Energy or Coal, Jobs and Displaced Carbon Emissions at Any Cost? Assessing Australia's Brown Coal v. Solar-Produced Liquid Hydrogen Exports to Japan

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Abstract

In a world shifting to a new global low carbon energy system and economy, renewable energy (RE) generation by Australia for export to its Asian neighbors could be part of a new renewables-driven political economy. We explore the complexities of energy exports and the tensions between the use of fossil fuels versus renewables for energy exports. We first outline Australia's potential in the transition to renewables and its current national energy policy paralysis. The Australian government has entered into an agreement to export hydrogen to Japan in a purposebuilt Japanese shipping fleet. However, the agreement is based on using lignite (brown) coal from the ailing Gippsland mining industry. The comparison of solar versus coal-produced liquid hydrogen exports to Japan is assessed against seven lenses or filters: the public interest 'No-net-detriment to Australian consumers' test; Australia's Paris 2015 carbon dioxide (CO₂) reduction commitment; other environmental impacts such as production-related emissions and embedded energy in shipping infrastructure; socio/political national benefits to GDP; impact on Australia's energy security; socio/political assessment of impact on Australia's energy-related foreign policy and Australia-Japan relations; and the way that using coal to generate hydrogen for export to Japan undermines Australia's commitment to the 2015 UN Sustainable Development Goals (SDGs).

Keywords: *liquid hydrogen, lignite coal, solar hydrogen generation, hydrogen exports to Japan, UN SDGs, product life cycle emissions.*

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Cleaner production to adapt to climate change: A stakeholder Delphi survey in a heavily affected district in Vietnam

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Abstract

As compared to mitigation of climate change, adaptation is often the poor cousin. Nevertheless the combination of the increasing reality of climate change effects and the inertia of the international community to reduce the greenhouse gas emissions makes adaptation (in combination with mitigation) increasingly important. Adaptation measures and actions are indicated in each sector affected by climate change impact. Most obvious they gradually appear managing:

- Biodiversity,
- Agriculture and forestry,
- Green and smart cities,
- Water security,
- Tourism,
- Extreme climate conditions and disasters.

The challenges raised in each of these domains differ, which results in a wide variety of actions, replies and responses: from nature-based solutions, over green roofs and bio-economies, to region tailored policies. This contribution analyses the diversified role of cleaner production in a context of adaptation to climate change related hazards in middle-Vietnam. Ky Anh is a district which is heavily and increasingly affected by recurrent storms. The adaptation capacity of the 20 coastal villages of the district is analyzed using a two rounds Delphi approach involving 36 panel members, representing the four major stakeholder groups in the area (authorities, farmers, fishermen, fish traders). They were invited to complete a questionnaire covering pressures, state, and responses of the local climate change associated events.

The replies to the adaptation part of the questionnaire revealed that after the main storms the measures by the local authorities, including construction policies, upgrading of dykes and irrigation systems, and the provided postdisaster assistance, were qualified as inadequate. The panelists suggested acting on:

- Planting larger areas of mangroves and other coastal protection forest.
- More investment in waste management.
- More investment in renewable energy (wind, solar, biomass).

Acting on "cleaner production" is an effective concept increasing the environmental, economic, social and health sustainability of the most necessary actions in these heavily affected regions.

Keywords: *climate change, adaptation, Delphi.*

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21st June 2018

15h00-16h30	Session 5B	Room 2
Analysis of yield of Aroeira Vermelha fruit extract via solvent extraction - Factorial Planning 2E+03		
Sustainable Development, Energy Efficiency and Environmental Impacts in Coffee Farming Process		
Organic Alternatives for the Achievement of Cleaner Strawberry Production in Pamplona Norte de Santander		
A phenomenologically based airline model of a 2 MW Gas Engine		
CSytemic Appropriation and Innovation: the case of humidification in the granite mining sector		

Analysis of yield of Aroeira Vermelha fruit extract via solvent extraction - Factorial Planning 2³

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Abstract

The main extraction processes function is the separation of components present in different materials. The isolation of different compounds, purpose of extraction, plays a prominent role in several industrial areas, including essential oils and essences in general. Therefore, the extraction process can be used to obtain substrates, which in this work will be aroeira vermelha (*Schinus terebinthifolius*) the raw material used demands of special interest of the industrial sector in the medicines and foods areas. Researchs are necessary for operational improvements in this area, due to the high added value of essential oils and essences as final product, extracted from this material, linked to the inputs minimization used on sustainability. Still, there is scope for using new solvents, with the aim of guaranteeing the sustainability of the process. In this sense, the present work has the objective evaluating the solid-liquid extraction process to obtain oils and essences from fruits of aroeira vermelha, using less aggressive solvents, seeking the procedure optimization. After obtaining the necessary raw material, the extraction procedure was carried out using the technique of extraction by solvents, hexane and ethanol, with humidity and maceration like process conditions. The results obtained were analyzed by the use of factorial design 2³, with the purpose of qualifying and quantifying the relevant variables statistically to obtaining better results. Better process conditions were verified using the solvent ethanil, with the raw material macerated, being the humidity condition irrelevant in this experimental procedure. Linked to the objectives of improvements and sustainable development and cleaner production, these results are satisfactory, considering the use of reusable solvents and optimization in the extraction processes due to the use of experimental planning.

Keywords: *Red Aroeira, Extraction, oils and essences, factorial planning.*

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Sustainable Development, Energy Efficiency and Environmental Impacts in Coffee Farming Process

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Abstract

Efficiency and environmental impacts are key factors in the different dimensions that integrate the relationships between Energy, Territory and Development (ETD), so they can be treated as inherent characteristics of the systems under analysis, whose measurement and evaluation allows to obtain a vision about the dynamics of energy use and the use of resources while promoting the formulation of strategies to jointly achieve the maximization of the desired results and the minimization of the negative impacts associated with existing processes. This paper presents the results of the study of energy efficiency and sustainability in a sample of farms producing coffee in southwestern Colombia; This work is based on the application of a study of energy synthesis for the use of a unit of homogeneous measurement of energy, matter and information flows. Emergy results were also integrated with data envelopment analysis (DEA) for the joint assessment of energy efficiency using the different sources, inputs, products and environmental effects, thus seeking to encourage the analysis and formulation of development strategies in the territory.

Keywords: *emergy synthesis, energy efficiency, emissions, coffee production, sustainability.*

Organic Alternatives for the Achievement of Cleaner Strawberry Production in Pamplona Norte de Santander

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Abstract

The strawberry crop is the third in importance in Pamplona, Norte de Santander. The plantations receive indiscriminate applications of fertilizers and chemical pesticides. The objective of the study was to evaluate organic control alternatives for foliar and soil diseases, slugs, and to replace the lack of phosphorus with a view to achieving cleaner strawberry production. Four trials were developed in strawberry fields, one for the control of diseases of the aerial part, the second for the control of diseases of the roots, the third for the phosphoric nutrition and the fourth for the control of slugs. In the first three, different bioproducts produced locally with efficient microorganisms were evaluated and in the last one the diatomaceous earth. The Caldo Rizósfera and ME bioproducts showed similar results to the Dithane protective fungicide against Ramularia spot, the anthracnose on leaves, flowers and fruits, Botrytis rot and bacterial spot, while Caldo Rizósfera, ME and M6 were similar to the fungicide Benomil and Sodium Phosphite for the control of root diseases caused by Fusarium spp. and Phytophthora fragarie. Caldo Rizósfera and M6 decreased the incidence and severity of phosphorus deficiency and favored a higher concentration of phosphorus in the leaves. Diatomaceous earth demonstrated efficacy for the control of slugs with two applications, doses between 4 and 8 kg/ha t.

Keywords: *pesticides, fertilizers, environment.*

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A phenomenologically based airline model of a 2 MW Gas

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Abstract

With the continuous advance and technological growth of society, the demand for energy has increased, more specifically the consumption of electrical power. This has led to the development of renewable energy sources such as wind power or solar energy. Despite their numerous advantages, such as environmental and economic benefits, at an industrial level, higher reliability and generating capacity energy sources are preferred. Because of this, nowadays many industrial sectors prefer fossil fuel-based energy generation, frequently using turbines and internal combustion engines as a primary energy source. The choice of one or other primary energy generation option depends on how variable the electricity demand is, as it causes continuous change in generator load. If a constant energy demand and economic feasibility study are required, a gas turbine can be chosen, despite having lower thermal efficiency than internal combustion engines. Otherwise, an engine is a better choice whether operating on diesel or natural gas as a fuel, because its high robustness allows it to adapt better to variable load rates. Considering the above, it is not surprising that in Colombia, a high percentage of industries uses generation engines to self-generate a part of its electric consumption. Considering that, usually, these generation engines must supply electrical power to industrial plants in a 24-7 regime, it is not feasible to keep them out of operation, neither in unexpected operation regimes for long periods of time. This, together with the manufacturer's restrictions and the laborious nature of making changes within the processing and control unit of an equipment, make it necessary to carry out a simulation of the system with its respective results, which can be transferred to the real system later. Therefore, the generator-engine assembly has been defined as a set of process systems, where the operational behavior of the equipment can be simulated using mathematical equations, obtaining a phenomenologically based semi-physical model that can be used to perform experiments in simulations. Finally, this work focuses on the implementation of the methodology for combining phenomenologically based semiphysical models to obtain a dynamic of the air line of a 2 MW Jenbacher natural gas internal combustion engine, focusing on modeling of mean values that involves the study of some engine parameters such as the intake manifold temperature and pressure, the mass flow through the throttle and turbo-bypass valve in the engine, the electric power and the gas emission.

Keywords: *Mean Value Model, Gas Engine, Phenomenological Semiphysical model.*

Systemic Appropriation and Innovation: the case of humidification in the granite mining sector

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Abstract

This article deals with a dimension of sustainable development that has not been extensively studied in literature: human work, that is, the work of those who are responsible for ensuring the production of goods and services. We propose to treat these questions from a research performed in the Brazilian mining region of the State of Espírito Santo. After the introduction of a norm, which aimed at protecting the workers' health, new types of equipment were introduced in the companies affected. Such step caused profound modifications in the workers' way of working and in the equipment itself. In this context, a process of systemic appropriation, which will be characterized in this article, is developed.

Keywords: *appropriation, innovation, work, prevention.*

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21st June 2018

15h00-16h30	Session 5B	Room 3
Evaluation of Key Factors, Productive Losses and Environmental Impacts in Palm Oil Production Process		
Comparison of Environmental Assessment Methods in the Analysis of the Energy Efficiency in Agricultural Production Systems		
Verification of the applicability of organic fertilizer, obtained in the composting and biodigestion processes, in the production of American		
Obtaining and Evaluation of Synthesis Gases from Biomass Gasification using Finite Element Analysis		

Evaluation of Key Factors, Productive Losses and Environmental Impacts in Palm Oil Production Process

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Abstract

Palm oil production is a coordinated activity that includes the execution of procedures, the application of specific techniques and processes and the integration of resources as equipments, labor, people, and materials in a way that each of them has a direct influence not only in the production, but the positive impacts of this activity as well. In this work it is applied a process of analysis, applied in a palm oil producing company located in the north Caribbean of Colombia. It is focused in the evaluation of five specific dimensions of the productive process and its resources complemented with the study of causes and effects according with Ishikawa. All of this work is intended to search for the particular conditions that determine the main loses and impacts attached with the extraction of palm oil, showing the effects of process standardization, the productive impact of the correct selection of materials, the level of education and training of people, the actual status of machinery and equipment and all the relationship between these elements over production loses, critical points of control in the process, biological, physical and social-economic impacts of extraction.

Keywords: *loses, production, palm oil, Ishikawa.*

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Comparison of Environmental Assessment Methods in the Analysis of the Energy Efficiency in Agricultural Production Systems

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Abstract

In recent years, various environmental assessment methods have been developed. The aim of this paper is to compare these methods to identify their advantages and disadvantages when used to analyze energy efficiency in agricultural production systems. A systematic review of information helped to identify six environmental assessment methods: ecological footprint, material flow analysis, ecological network analysis, life cycle analysis, exergy and emergy. A multi-criteria comparison was carried out, taking into account the level of formalization, system modeling, spatial scale, inventoried flows, type of indicators, relationship with the concept of efficiency and usability of each of the methods. This work allowed to highlight the strengths and weaknesses of each environmental assessment method. Proving that the Emergy approach, could provide a relevant framework for the analysis of the multiple energy flows that interact in an agricultural production system, and achieving an integral understanding of energy efficiency in the whole system.

Keywords: *Environmental Assessment (EA), Energy Efficiency (E.E.), Agricultural production systems, criteria.*

Verification of the applicability of organic fertilizer, obtained in the composting and biodigestion processes, in the production of American lettuce (*Lactuca sativa* L.)

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Abstract

In Brazil, there is a lack of consolidated initiatives for the recovery and recovery of the organic fraction, which has an overload in the final disposal systems, which receive approximately 71.34 million tons per year, of which 12.4 million tons are still deposited in dumps, the worst form of possible destination and daily source of environmental pollution, causing several health problems. Organic waste has the characteristic that it can be recycled through composting or biodigestion, at any scale, from the domestic to the industrial, providing an environmentally appropriate, low-cost and easily used organic waste disposal destination for the population and obtaining of a high quality organic compound. The present work has the objective of verifying the applicability of organic fertilizer, obtained in the composting and biodigestion processes, in lettuce production (*Lactuca sativa* L.). The food residues used in the production of organic fertilizer were collected at the Federal Institute of Paraná, Umuarama Campus. The organic matter was submitted to the recycling processes via composting and via biodigestion. The organic fertilizers obtained were applied in the production of lettuce, in experimental beds, under controlled environment, under greenhouse conditions. The parameters used for lettuce growth analysis were: number of leaves, height (cm), fresh mass (g) and dry mass (g). The biofertilizer performed efficiently on lettuce growth, presenting the most significant mean values for leaves, height and fresh mass, which were, respectively, 14.33 ± 2.31 , $19,67 \pm 1.76$ cm and 57.97 ± 4.10 g. For lettuce with compound insertion in the soil, the growth was impaired by the high pH of the soil. However, recycling of organic waste contributes to the reduction and disposal of organic matter with high contaminant potential. The management of this waste meets the objectives of sustainable development, contributing to the achievement of sustainable cities, responsible consumption and production.

Keywords: *composting, biodigestion, food waste, organic fertilizer.*

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Obtaining and Evaluation of Synthesis Gases from Biomass Gasification using Finite Element Analysis

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Abstract

Given the need to implement non-conventional sources for the generation of energy, it is necessary to characterize the natural or residual agro-industrial resources that can be used for the conversion of energy. In this work, a study is carried out to obtain the synthesis gas produced in a bioreactor using the gasification of biomass, such as pinewood, rice husk, coconut husk and palm shell, to analyze its potential as synthesis gas. This gas is obtained using a finite element software for the parameterization of the relevant models for the calculation of its production by biomass gasification through its final composition and the chemical analysis obtained from studies carried out on the physicochemical properties of biomass. As a result, the CO and H₂ production components are obtained for each biomass sample, evaluated at 1020K. These results are similar to those obtained by experimental designs, showing that using computational techniques a good approximation is received from the analysis of residual material for use as fuel.

Keywords: *synthesis gases, Biomass Gasification, finite element.*

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21st June 2018

15h00-16h30	Session 5B	Room 4
Optimal Planning of Drinking Water Production		
As simple improvements affect the eco-efficiency of road freight transport		
A Survey about Multi-Objective Optimization for Green Vehicle Routing Problems		
Energy planning for the development of the RECP: A case study in the hotel sector		
Social Reverse Logistics of Used, Non-Expired Medicines (UNEM) with Public Economic Burden? An Impact Appraisal from a Municipal Program		

Optimal Planning of Drinking Water Production

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Abstract

The water system is one of the most important issues for life and the planetary ecosystem, which is widely recognized by society and synthesized as one of the current research problems of the United Nations. One of the problems involved with this system is related to the treatment of water in treatment plants in a context of sustainable development. This article focuses on the problematic of the raw water treatment system for purification, through a mathematical programming model and a solution procedure for the optimal planning of the treatment system in its different steps and in a two objectives context. The linear model considers two objectives, the first maximizes profits and the second minimizes emissions of pollutants. As restrictions are considered: mass balances, production capacities of the different stages of water production in their different conditions, supply of water, demand and the permissible technical levels of pollutants, which are proposed in a generic manner, independent of the technologies and productive alternatives. The model by its nature allows to solve almost any instance of the problem in excellent CPU times.

Keywords: *optimal planning, production and treatment of drinking water, linear programming.*

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As Simple Improvements Affect the EcoEfficiency of Road Freight Transport

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Abstract

Currently the demand for the reduction of the generated environmental impact is one of the objectives of the organizations due to the external and internal pressures, that make the companies look for environmentally correct solutions for their operations. However, the difficulty is to make these green practices economically viable. Eco-efficiency aims to measure the impact caused and compare it with the value of the product and / or service. This indicator allows generating information for decision making to introduce an environmental management considered financially viable. This article was based on a model of evaluation of the ecoefficiency of the sector of transport of loads, which, was tested in a company and presented the ecoefficiency of the vehicles, as well as suggestions of improvements. In this article we tried to simulate those results in an ideal scenario to understand how to maximize ecoefficiency in this sector. It was perceived that the proposed improvements have a greater impact on the emission of carbon generated in the transport and increase the indicator of ecoeficiencia of the organization. This shows that, when simple measures are applied, companies achieve good results in an environmental and financial way. The article still presents a comparison with the current scenario and the discussions on the subject.

Keywords: *Transport. Performance evaluation. Eco-efficiency.*

A Survey about Multi-Objective Optimization for Green Vehicle Routing Problems

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Abstract

This article presents a survey about multi-objective optimization for green vehicle routing problems (MOOGVRP), that is, with environmental considerations. It makes use of a taxonomy that divides the MOOGVRP in: Green VRP, Pollution Routing Problem (PRP) and VRP in Reverse Logistics (VRPRL). The goal of the present paper is to detect the gaps in the literature that make possible some advances related to MOOGVRP. For this, this research approaches, briefly, the following topics: bibliometric data; taxonomy; main variations of the VRP used; proposed objective functions; number of objectives; solution procedures; main softwares and languages for implementation; the most cited works of the sample and their approaches.

Keywords: *Survey; Green Vehicle Routing Problem; Pollution Routing Problem; Vehicle Routing Problem in Reverse Logistic; Multi-objective Optimization.*

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Energy planning for the development of the RECP: A case study in the hotel sector

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Abstract

The hotel sector is among the activities with the highest energy consumption, constituting one of its main operating costs. The efficiency in the use of resources and cleaner production (RECP) as a preventive environmental management strategy enables the efficient use of energy through the application of various options and relying on components of the energy management system, such as energy planning. they facilitate the process and allow quantifying their benefits. This article focuses on the study of energy planning tools, their integration in the RECP methodology and their catalytic effect in the development of the same. A case study is presented in a hotel in the city of Barranquilla-Colombia, the energy planning tools support the development of the RECP's application methodology in the case of the hotel, providing relevant information for pre-evaluation, implementation and planning of continuity.

Keywords: *Energy planning, Efficiency in the use of resources and cleaner production (RECP), Energy management system.*

Social Reverse Logistics of Used, Non-Expired Medicines (UNEM) with Public Economic Burden? An Impact Appraisal from a Municipal Program

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Abstract

There is little research on the reverse logistics of medicines, because the wastes of the pharmaceutical industry are incinerated, or undergo other forms of physical-chemical destruction, given the potential risks they pose to the environment and to public health when incorrectly disposed. This situation is more problematic in developing countries, where the management of wastes is usually neglected by governments and citizens. Whilst product innovation thrives in the pharmaceutical sector, and an ageing population represents an increase in the demand for medicines, little effort is made to avoid their incorrect disposal. The negative impacts to the water and to the soil quality derived from improper management of used medicines is a challenge in emerging economies. This research describes a local government program of reverse logistics for used, non-expired medicines (UNEM) in a small municipality in Southern Brazil. Taking as a reference the available data of collected and donated quantities of UNEM, and the number of persons that received UNEM for free from July 2015 to December 2017, it was possible to perform an environmental and socioeconomic appraisal of the program. The main findings are that reverse logistics, besides the strictly economic aspect stated by law (as return of a good to the business sector), can have a socioeconomic benefit for needy communities. In the studied case, the reverse logistics avoided environmental harms and economic spending of around US\$ 1.5 million with the proper destruction of UNEM medicines; an average of 90 persons benefited every week through receiving UNEM for free; the indirect income distribution per capita, with the program, reached more than 17% of the minimum wage established by law in Brazil. However, the Public Administration carries an economic burden for the correct disposal of the medicines that expire before being dispensed. It amounted around US\$ 4,000 since July 2015 to December 2017. As the population does not correctly separate and dispose used medicines, and considering that incorrect disposal of these products represents health risks that will end in the public health system as another type of economic burden, public and private, the Public Administration initiative, even ending in economic spending for the collectivity, results probably less costly than to simply do nothing and push this problem for the future. This private-public economic burden is an open issue for the current local system of reverse logistics. Further investigation is necessary to enable the possibility to replicate this program to other municipalities; and it presents an opportunity worthy of investigation in other newly industrialised countries.

Keywords: *medicines wastes; impact assessment; impact appraisal; reverse logistics.*

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21st June 2018

15h00-16h30	Session 5B	Room 5
The Labor Market for Touristic Services Carried out in Private Reserves of Mato Grosso do Sul Natural Heritage		
Temporary and Typological Series of the Administrative Procedures of the Municipal Environmental System		
Proposal of Calibration of Questionnaire for Evaluation of Happiness		
Meaningful work: a review of an organizational change towards health and well-being at work		
Motivations of Social Networks Users to the Engagement in Solidarity Actions		

The Labor Market for Touristic Services Carried out in Private Reserves of Mato Grosso do Sul Natural Heritage

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Abstract

The aim of this paper was to analyze the behavior of the labor market indicators related to the inputs of the tourist services production chain in the state of Mato Grosso do Sul. The research is justified due to the high number of tourist attractions in the state and characterized as natural and ecological. For this, the Social Life Cycle Assessment was used as methodological procedure, based on data collected in the Social Information Relation, from 2006 to 2015, and in the Information and Technology Company of the Social Security, from 2006 to 2014. The periods were selected according to the availability of information. The National Classification of Economic Activities was used to select the tourist activities that could be related to the Private Reserve of Natural Heritage, one of the categories of conservation units as provided for in the Brazilian legislation. The results indicate that the economic activity in hotels and similar establishments has the largest number of formal employees, that there is a difference in the average salary paid for men and women and there are also different salaries between Brazilians and non-Brazilians. In addition, there was a reduction in unionized employees and the risk of work activities increased. Therefore, it is believed that there is a need for investments in enterprises with activities that contribute to improvements for the employees as a measure of social responsibility.

Keywords: *Labor Market; Touristic Services; Conservation Unit.*

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Temporary and Typological Series of the Administrative Procedures of the Municipal Environmental System

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Abstract

Environmental impact assessment is a useful tool for identifying, quantifying and defining measures to mitigate potential impacts. This serves as the basis for the license, legally provided for undertakings with potential impact. It's observed that the municipalization of the licensing may allow them to come into contact, seeking synergistic processes of local partnerships, both in order to make their business viable, as well as to exchange experiences, as well as to search for new markets. By means of a case study, as well as a bibliographical and documentary survey, we intend to analyze a time series from 2012 to 2017 of the environmental licensing data. It's observed that 2017 presented a greater number of licenses, with the Regularization of Operating License being the most frequent procedure in all the years. As for the other procedures, the Environmental Services Authorization presented a high number in 2017, being the most frequent procedure in most other years. The economic activities with potential pollution was typified in four groups of similarity, which are related to the sectorial potential impact, and this study has relevance so that the environmental licensing precepts procedures are more in tune with the real impact potential of the activities.

Keywords: *Environmental licensing; Impact; Economic activity*

Proposal of Calibration of Questionnaire for Evaluation of Happiness

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Abstract

This paper presents a proposal for the calibration of a questionnaire for the evaluation of happiness. The calibration aims at the practicality of the instrument with similar valuation to that obtained by the application of the questionnaire model of the Bhutan Studies Center (BSC). Initially, the BSC model questionnaire was adapted, excluding questions linked to specific cultural aspects of Bhutan, and the open-ended questions were transformed into closed-ended multiple-choice questions. The BSC model questionnaire has 209 questions, which integrate 33 indicators divided into 9 domains. This extensive questionnaire requires considerable time, resulting in little practicality and high application costs. For this reason, from the extensive questionnaire, a reduced questionnaire was formulated with care to maintain the 9 domains (psychological, time use, health, education, cultural diversity, good governance, community vitality, ecological diversity and standard of living). Questions were taken from the extensive questionnaire so that the score resulted in an amount equal to or greater than 70% of the total domain. The reduced questionnaire had 79 questions and 21 indicators. The two questionnaires were then applied (extended and reduced) for two study groups: a group of 6 postgraduate students and the other 6 family heads of a low-income community. In this experiment, the time of application and the level of sufficiency reached in each domain was evaluated. The average application time went from 3 hours (extensive questionnaire) to 30 minutes (reduced questionnaire). However, when comparing the final score scores by domain (sufficiency level) of the extensive and reduced questionnaires, differences (for each study group) were observed in the sufficiency level in some domains. To achieve the same result by using the reduced questionnaire, calibration criteria were developed. The criterion for intervention in the reduced questionnaire was to add questions until a similar value was obtained for the level of sufficiency, and the difference of one level of proficiency per domain for a single interviewee was tolerated. As a result of the calibration, the student group questionnaire had 111 questions and 26 indicators. In this case, there was intervention in the areas of cultural diversity, well-being and ecological diversity. In the case of the interviewees from the low-income community, the questionnaire, after calibration, had 107 questions and 25 indicators, being calibrated the areas of the standard of living, education, community vitality and ecological diversity. The results show that depending on the target population, the domains to be calibrated may vary. The calibrated reduced questionnaire, besides reducing the application time by 6 times, about the extensive questionnaire, results in a similar assessment of happiness. A calibrated questionnaire, the result of this research, can contribute to public policies, where they influence people's way of life.

Keywords: *Happiness. Calibration of the questionnaire. Gross Domestic Happiness.*

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Meaningful work: a review of an organizational change towards health and well-being at work

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Abstract

This article aims to present a literary review of workplace spirituality as an approach for meaningful work. This topic has been discussed in regards to organizational changes by journals. As the authors discuss spirituality, it may be noted that this topic is about a tendency of the last generation of workers seeking more meaningful labor. However, job satisfaction cannot be measured only by financial returns and growth opportunities for recent workers. Old working objectives were replaced by new work objectives that could increase the experience of meaningful work. In this article the preview literature about workplace spirituality was reviewed with the objective of finding the main work attributes that support this new perspective for job satisfaction. A systematic literature review was done to identify the key work attributes and propose a job satisfaction diagnostic instrument in order to attend new jobs' expectations. The diagnostic instrument was based on Kano's Model, which maps the workers' satisfaction level related to the work attributes. It is expected that the proposal of this instrument contribute to the organizational efforts of developing more health and well being in workplaces through job satisfaction.

Keywords: *meaningful work; organizational changes; health and well-being.*

Motivations of Social Networks Users to the Engagement in Solidarity Actions

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Abstract

Social inclusion is a much-debated topic, both in the academic and business world, and in society as a whole; however, little is done so that this inclusion, in fact, happens. Thus, the main objective of this article is to analyze the predisposition of social networks users to participate in solidarity actions, to contribute to the social inclusion of the population, which is in a condition of socioeconomic vulnerability. We collected data through a questionnaire, made available in Google Forms, obtaining 1198 valid answers. Among the results, we obtain that, the main motivation to carry out solidarity actions, is the personal satisfaction with 44% of the responses and spiritual growth with 16.8%. It was possible to outline the volunteers' profile and the feasibility of developing future projects.

Keywords: *social networks; social inclusion; solidarity actions.*

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21st June 2018

15h00-16h30	Session 5B	Room 6
The Materiality as a Competence of Enterprise Transformation under the Perspective of Sustainability		
The Establishment of Energy Baselines According to ISO 50001: A Contribution to the Cleaner Production in the Industry		
Remanufacturing process for mechanical transmissions of commercial vehicles: Case study in automotive company		
Improving Cleaner Production through Biologically Inspired Urban-Industrial Networks		

The Materiality as a Competence of Enterprise Transformation under the Perspective of Sustainability

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Abstract

The goal of this research is to check if the materiality can be considered as a competence of enterprise transformation in a sustainable conception. A secondary intention is listing and ranking other possible competencies that may change the enterprise scenery through Triple Bottom Line premises. The approach used to solve this gap is the Delphi research. This method is responsible for extracting a consensus among experts in this topic. To sort the abilities, the tool Qualtrics and the Mudge Method have been chosen. The last one has a goal of minimizing subjective factors that are inborn to human being's routine, creating a more efficient decision-making process. As one of the main discoveries, this research found out 9 nine necessary competencies to make an enterprise transformation on the mentioned topic. Also, it was confirmed that the materiality can be deemed as one of these abilities, and that it can contribute to this selection and, therefore, help companies to reach their Sustainable Development Goals. The limitation of the study is in the absence of details on how to implement such competencies at the everyday enterprise routine. In the sense of being original, this paper is the first to broach the necessary competencies of transformation with the sustainable pillars and also when giving applicability to the newly developed definition of materiality.

Keywords: *Enterprise Transformation, Materiality, Sustainable Development Goals (SDG), Delphi Method, Mudge Method*

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The Establishment of Energy Baselines According to ISO 50001: A Contribution to the Cleaner Production in the Industry

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Abstract

Generally, companies focus on reducing the use of energy in facilities and related carbon emissions. In this sense, energy management plans are created, energy reduction goals are set and operations are modified or energy efficient technologies are applied to reduce energy losses. To evaluate the effectiveness of their actions and investments, companies promote ways to measure the performance of their energy management programs. An integral part of measuring energy efficiency is the establishment of energy baselines applicable to the entire facility, which provide a starting point to evaluate improvements in efficiency. It is here that the implementation of energy management systems aligned to the requirements of ISO 50001, constitutes a contribution to the purposes and strategies in the improvement of cleaner production in the industry. This is one of the options that the industry has to establish energy references that allow evaluating performance, predicting energy consumption, aligning production with lower raw material and primary and secondary energy resources, with the production of cleaner products taking precedence. benefit the environment, being energy efficient and complying with the general objectives of cleaner production.

In this article, an alternative is proposed to establish energy baselines for the industry in which several products are produced through a single raw material and determines the energy expenditure of each product and its impact on the overall efficiency of the product. industry. The method is validated in a case applied to the plastic injection process and as a result an energy baseline (LBE) is obtained in accordance with the requirements of ISO 50001 that serves as a reference to determine energy savings that contribute to the production objectives cleanest in the industry.

Keywords: *Energy efficiency, sustainable consumption, Iso50001, Normalization Energy baseline*

Remanufacturing Process for Mechanical Transmissions of Commercial Vehicles: Case Study in Automotive Company

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Abstract

The growing need for companies to adapt to a highly competitive market in relation to prices and environmental issues makes them look for alternatives that were previously not needed or well exploited. In this sense, the remanufacturing process has been explored by companies aiming to increase not only profit but also trying to generate a positive ecological impact. The automobile company, for this case study, has had a remanufacturing process for commercial vehicle transmissions for some years, but through commercial indexes, it saw the need to update this process. Indicators of sales losses, prohibitive cost of the remanufactured part and deadlines above the market in delivery of remanufactured transmissions motivated the project in question, which aims to diversify the medium as the company interacts with its target audience. Through a market analysis, preliminary product evaluation and remanufacturing product recall process improvements were studied in the current process. The main improvement implemented was a more detailed analysis and subdivided into levels of repairs guaranteeing greater productivity, lower cost and time in the response to the final customer. The process of communicating with distributors has also been stepped up to better ensure product evaluation and timely delivery. In short, better and more effective processes, communication channels and greater differentiation of products for remanufacturing were the points executed and the results expected in this project.

Keywords: *Remanufacturing; sustainable life cycle; Mechanical transmissions; Automotive industry.*

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Improving Cleaner Production through Biologically Inspired Urban-Industrial Networks

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Abstract

Biologically-Inspired Design is a growing field that has many applications. While this is normally used for individual products or materials, applied at a systems level, the inspiration stems from the structure and makeup of ecosystems. Over the last few decades, ecologists have developed Ecological Network Analysis (ENA) to better understand ecosystems, and both industrial and urban systems have been analyzed using ENA. Specifically, Eco-Industrial Parks (EIPs) that look to mimic the cyclic nature of food webs have been analyzed using ENA showing that these networks can still be improved significantly before they reach the levels of observed natural food webs. Similarly, urban networks (such as water and energy networks) have been looked at with ENA at a high level with insight gained about trophic levels in a city and how they compare with food webs. However, the industrial and urban networks have been analyzed at different scales and in separate systems. In this paper, we propose to further the use of ENA for industrial and urban networks. Specifically, the industrial networks will be combined and analyzed with the urban networks. This better represents how these networks function in reality whereas before some critical connections may have been ignored. A case study will be used to exemplify the method and benefits of our approach.

Keywords: *biologically-inspired design, ecological network analysis, industrial ecology*

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21st June 2018

15h00-16h30	Session 5B	Room 7
The potential for gasification of coffee stems to provide bioenergy for the coffee sector		
Solid Fuel Produced from Mandarin Peels and Rice Husks		
Thermodynamic and economic simulation of organic Rankine cycle coupled with natural gas stationary engines		
Life Cycle Assessment of the production of biodiesel from the Seeds of Tabaco Solaris		

The Potential for Gasification of Coffee Stems to Provide Bioenergy for the Coffee Sector

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Abstract

The coffee industry represents an important part of the global economy, particularly for developing country producers. Here, the industry provides foreign exchange earnings and livelihood to around 25 million smallholder farmers growing almost 80% of global coffee production. The scale of this industry poses a challenge with the utilization or disposal of the residues generated along the coffee cultivation-processing chain. Coffee stems, obtained after coffee tree pruning, are one of those abundant and untapped resources in the coffee supply chain. Their lignocellulosic content and gross calorific value of 19.7 MJ/kg make them a suitable solid fuel for thermochemical conversion processes. Using a process modelling approach and the Colombian coffee sector as a case study, this research evaluates the feasibility of using these residues in small-scale downdraft gasifiers coupled to internal combustion engines (ICE) for power generation and recovery of low-grade heat. The producer gas heating value of 5.6 MJ/Nm³ and the gasifier's performance characteristics (e.g. cold-gas efficiency of 71%) show that this gas could be utilised in ICE devices for power generation. The overall system efficiency of 45.6% also indicates that the deployment of these systems could be attainable, particularly if low-grade heat is recovered for the coffee grain drying in the Colombian coffee sector. An analysis of the energy demand and coffee stems availability within the sector shows that medium-to-large scale coffee farms (with average coffee productions of 25 t/year and cultivated lands above 5 ha) offer particularly attractive opportunities to deploy this bioenergy system. The biomass production level in these farms is well matched to their energy demands from the coffee-processing chain and household applications. Overall, this work adds to the existing knowledge base by assessing the feasibility of providing coffee stems-sourced low carbon energy for global coffee production at relevant operating scales.

Keywords: *Coffee stems; Gasification; Process modelling; Biomass resource availability; Power generation; Low-grade heat recovery; Coffee drying*

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Solid Fuel Produced from Mandarin Peels and Rice Husks

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Abstract

Biomasses like tangerine peels and rice husks are seen among the most abundant and accessible sources for conversion into products with a higher added value. One possibility is the production of solid fuels for the decentralization of energy production and utilization of agricultural residue. It is important to highlight that sustainable bioenergy must have high efficiency, therefore we have evaluated the higher and lower heating values of the specimens produced from rice shells husks, mandarin peels, cornstarch, glycerol, citric acid, and acetic acid. We have determined the total moisture content, ash content, and higher and lower heating value of the sixteen collected specimens. We have also determined the compressive strength, in which all samples presented a maximum resistance appropriate for the storage and handling of the developed solid fuels. The composites with a higher quantity of mandarin peels showed greater higher and lower heating values, of 19.18 MJ/kg and of 17.92 MJ/Kg, respectively. All developed samples have shown to be capable of replacing traditional heat sources like firewood (7.12-10.47 MJ/kg) with a better energy performance.

Keywords: *Solid Fuel, Rice husks, Ponkan peels*

Thermodynamic and Economic Simulation of Organic Rankine Cycle Coupled with Natural Gas Stationary Engines

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Abstract

Waste heat energy sources, such as stationary engines exhaust gases, are suitable for the energy generation via organic Rankine cycle (ORC). This document combines a thermodynamic simulation and an economic analysis of the performance of a Cummins stationary engine with an ORC as a bottoming cycle, by using different organic fluids. The maximum output power is less than 165 kW while the temperature of the heat source varies between 200 and 250°C. The studied working fluids, namely R245fa, R1233zd (E) and R1234ze (Z), are selected based on environmental, safety and thermal performance criteria. The Levelized Cost of Energy (LCOE) and the Specific Investment Cost (SIC) for the maximum output power are presented. Results showed that R1233zd(E) achieves the highest net power output. R1233zde(E) increases net power production up to 9.3% and 165 kW, when it is compared to the stationary engine power output. Results also showed that R245fa is the fluid with the lowest net power production. R245fa increases net power production up to 8.3% and 148 kW, when it is compared to the stationary engine power output. Finally, results showed that thermal oil temperature of 200°C reduce the LCOE of ORC. R1233zd (E) is the most cost-effective fluid, with a LCOE value of 5.3 cents USD/kWh and an SIC value of 429 USD/kW.

Keywords: *ORC, Waste heat, natural gas, organic Rankine cycle, exhaust gases.*

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Life Cycle Assessment of the Production of Biodiesel from the Seeds of Tabaco Solaris

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Abstract

The objective of this work is to analyze the life cycle of the agricultural production of Seed Solaris for purposes of obtaining biodiesel in the region of Santa Cruz do Sul. Mainly in this municipality of Rio Grande do Sul, there is a high tobacco production aiming at obtaining leaves to be used in the manufacture of cigarettes. Solaris tobacco, known as energetic, has been installed in experimental farming and has an agricultural production similar to conventional tobacco. In this sense, we performed the evaluation of the stage of seed production using Life Cycle Analysis and thus, recognizing, during the stage of experimental crops, what can be improved in the production to reduce the environmental impact. The work was done taking into account the resources needed to obtain 1kg of seed as a functional unit in the SimaPro 8.5 software, using the Ecoinvent 3.4 database, and the ReCiPe 1.06 evaluation method in the hierarchical perspective, other methods were also used for comparison purposes. It has been found that compared to other biodiesel production lifecycle assessment initiatives, it is understood that producing Solaris tobacco seed biodiesel leads to similar impacts to those identified with other crops, with total damage to the production of 1 kg of Solaris tobacco oil biodiesel of 1.07E-05 Daly, 7,13E-08 species.yr and 1,42E + 01 \$, for categories related to human health, ecosystem and natural resources, respectively.

Keywords: *Energetic Tobacco, Solaris, LCA, LCIA, SimaPro*

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21st June 2018

15h00-16h30	Session 5B	Room 8
An Assessment study of the monthly complementarity of renewable energy resources in Colombia		
Colombian Clean Fuel Matrix: Current Scenario and Opportunities for Biofuels Enhancement		
Geospatial assessment of the wind energy for an onshore project in the Caribbean region of Colombia		
External Auditing of Corporate Social Responsibility Projects: Case Study of CSR projects for Energy Company in Thailand		

An Assessment Study of the Monthly Complementarity of Renewable Energy Resources in Colombia

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Abstract

In order to assess the feasibility of a combined use of renewable energy sources over a determined region, it is necessary to carry out complementarity studies. These studies let us know the generation profile of renewable energy sources, with high variability, over a specific interval of time and establish a possible match between two or more different energy sources. Such is the case of wind and solar energy sources. In this paper is presented an assessment study of the monthly complementarity of wind and solar resources over Colombia for electricity generation. It is proposed to assess the complementarity based on a novel approach, using a dataset obtained from high-resolution images of wind and solar monthly resource maps of Colombia; images previously treated using image processing techniques. Then, the dataset is used to calculate average energy generation on each month of the year, and the complementarity of both renewable resources is obtained calculating the degree of correlation between them, with the Pearson correlation coefficient. The obtained results show a good degree of complementarity between both energy sources in some regions of Colombia, at the different seasons of the year. The results obtained in this study can be useful to identify regions with high potential of installation of power generation plants based on wind and solar energy.

Keywords: *complementarity study, image processing techniques, photovoltaic energy, wind energy.*

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Colombian Clean Fuel Matrix: Current Scenario and Opportunities for Biofuels Enhancement

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Abstract

In Colombia, since 2005, diverse technologies for biofuels production have been studied and implemented in the search for alternatives to fossil fuels. The main biofuels produced in the Colombian fuel matrix are bioethanol and biodiesel. Only few cases are reported on industrial biogas production. This study presents the Colombian biofuel potential and the actions expected for its development in the national market. The main findings of this research study are: Colombian biofuels regulatory framework is constantly being updated, strategies for the development of bio-based economies on rural areas in small-scale production facilities is being promoted, and sustainable rural developments practices based on GIS modelling are being considered. The main objective of this paper is to evaluate the impact of biofuels on the transportation sector, to assess the opportunities for the Colombian fuel matrix, and to assess the preparedness of the regulation to promote and sustain biofuels on the market. Further research is expected to forecast biomass valorisation scenarios in which studies based on second generation biomass conversion technologies are needed to validate economic feasibility of new projects of industrial facilities.

Keywords: *Biofuels, energy matrix, diversification strategies, regulatory framework*

Geospatial Assessment of the Wind Energy for an Onshore Project in the Caribbean Region of Colombia

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Abstract

Colombia is setting a national renewable energy target providing a clear indication of the level of renewable energy development and the timeline envisioned by 2020 with almost the 7% of the energy production excluding large hydropower plants shall be generated from renewable energies. In Colombia the wind potential is outstanding, the Northern Caribbean region of the country alone has almost 20.000 MW of capacity (Huertas L., 2007) but the real wind energy potential of all Colombia's regions has to be defined, for this reason, this study is a useful start to generate research findings to uncover suitable sites for developing wind energy. This study provides a more precise and differentiated assessment for an onshore wind energy farm in the Northern Caribbean region of Colombia selecting study areas of three Colombian's departments (Atlantic, Magdalena and La Guajira). Likewise, wind energy potential assessment integrates socio-political, environmental and techno-economic criterion in a geographic information system (GIS) combining with a multi criteria decision making (MCDM) with its analytical hierarchy process approach. The purpose to find potential sites for build wind farms combining geographic information systems (GIS) and multi criteria decision making (MCDM) with the analytical hierarchy process (AHP) approach. Since onshore wind energy siting is inherently multifaceted, an approach capable of evaluating several criteria simultaneously must be used. Geographic information system (GIS) have the ability to assimilate, analyse, and visualise multiple spatial data sets that pertain to the different factors used for site selection, but GIS is limited in its capacity to assign values to these factors. Thus, a multi-criteria decision-making (MCDM) must be generated since this approach has been shown to be an effective technique for assigning values to different criteria, and it is compatible with the functionality of GIS. Generating three models, the restriction model, which will indicate the areas excluded to develop wind farms, the rated model performing an evaluation of the different criteria used to develop a wind farm. The result of these models can be easily displayed on the web to provide free, quick access for those interested in onshore wind energy siting, and increasing access to this type of information has been shown to enhance public participation in the siting process. Following the result of the suitability model, 3.1% of the total study area is characterized by very high suitability (value score 5), 37.73% by high suitability (value score 4), 2% medium suitability (value score 3), low suitability (value score 2), and the rest 55.24% is excluded area (value score 0). Based on these findings, there is sufficient space available for developing a wind farm in the north Caribbean region, especially in the selected study area. This study can have an extraordinary impact on the public through the production of interactive web-based maps, promoting wind energy planners and renewable energies students to develop wind farms with different constraint and criteria.

Keywords: *Affordable and clean energy, climate action, onshore wind farm, wind potential, geographic information system (GIS), multiple criteria decisions, MCDM, analytical hierarchy process (AHP).*

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External Auditing of Corporate Social Responsibility Projects: Case Study of CSR projects for Energy Company in Thailand

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Abstract

The concept of auditing CSR toward sustainable development is connected with social, environmental and economic dimensions. Today, growing number of companies issuing such CSR projects is a part of their annual reporting. Despite there are problem in evaluating their quality. Each of the projects is different in the contexts and characteristics; consequently, the results of the CSR project are diverse. The aim of this paper is to design and determine the key performances indicators for comprehensive evaluation of sustainability CSR projects. Four CSR project case studies of energy company in Thailand are also used to verify the proposed methodology which based on ISO26000:2010 and GRI:G4 guideline. The study showed that the projects are worth for the investment as the "Social return on investment" (SROI) was greater than 1 in all of the CSR projects. Also, the CSR projects can reduce the cost and increase revenue for participating communities according to the value of direct economic value generated and distributed from the positive impacts of environmental and social conditions by the project operation. For the environmental indicators, GHG emission mitigation from the project operation is considered and converted to carbon credit value. Social performances indicators were evaluated in the form of the value or benefit for community or society from project operation. Sustainability of CSR projects offers a comprehensive principle to create shared value in order to build a more satisfaction on stakeholders, sustainable development toward society in collaboration with economic success.

Keywords: *Corporate Social Responsibility, Sustainability Development, Economic indicators, Environmental indicators, Social indicators*

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“CLEANER PRODUCTION FOR ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS”

Barranquilla – Colombia – June 21st - 22nd - 2018

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21st June 2018

16h50-18h50

Plenary Presentations

Carlos Poveda

**Netherlands Organisation for
applied Scientific Research
(TNO) – Netherlands**

Creating Value from Industrial
Waste

Chantal Block

2C Ecosolutions – Belgium

Circular Economy, a Way to
Sustainability?

Samira Garcia-Freites

University of Manchester – UK

Cleaner Energy Production to
Support Sustainable Agriculture
in the Global South

Soraya El-Deir

**Federal Rural University of
Pernambuco – Brazil**

Education for Sustainability

Creating Value out of Industrial Waste

Carlos Poveda
Netherlands Organisation for Applied Scientific Research (TNO)
Netherlands

In most productive sectors, the transformation of raw materials into finished products for sale and consumption, generates significant environmental impacts, including production of by-products, and solid and liquid waste, which if not used, should be disposed. Many of these materials contain a significant potential of generating value, either as raw material for other industries or also, through their transformation into high-value ingredients or alternative energy sources. The valorization of these materials represents for the Industry new ways of savings on operational expenses, and also additional income from their commercialization.

On this conference, we will discuss practical examples of transformation of residual biomass into alternative energy sources and chemical ingredients.

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Circular Economy, a Way to Sustainability?

Chantal Block
2C Ecosolutions - Belgium

In 2015, 7 billion ton of raw materials were consumed in the EU-28. High dependency on imported resources (ca. 90%) exposes Europe to price volatility and geopolitical uncertainties and creates a competitive problem for the manufacturing of goods as materials and imported components are an important part of the total cost. Moreover, the production of raw materials generates a lot of environmental problems in the countries of origin. Current production levels of some "critical materials" such as Li and Co, are not sufficient to meet the material demand for the production of sustainable energy in Europe. It is consequently important for Europe to optimise its raw material consumption and to keep these raw materials as long as possible in circulation.

Although in Europe ca. 40 % of our waste is recycled, resource consumption can further be reduced by implementing the principles of Circular economy (CE). Circular Economy aims at decoupling economic growth from resource constraints by maintaining material and resources as long as possible in the economy. It goes farther than the conventional "reduce, reuse and recycle" as it also comprises "material repurposing and rethinking", "product repair, refurbish and maintenance". To reach the goals of Circular Economy new collaborations between designers, producers, waste managers, services and consumers are needed. They will result in innovative production systems based on eco-design, in efficient dismantling methods for end-of-life products, in thorough selective collection systems for waste, in elaborated procedures for material recycling and reuse of product parts...but also in a change in mentality, new consumption patterns and new business models.

All these aspects of circular economy will be illustrated by examples from different sectors. Finally, cleaner production and circular economy, 2 concepts to reach sustainability, will be compared.

Cleaner Energy Production to Support Sustainable Agriculture in the Global South

Samira Garcia-Freites
University of Manchester
UK

Colombia is a developing country with a significant biomass-based energy potential from agricultural residues (~330,000 TJ/year), however, almost 50% of these resources remain untapped within traditional biomass practices. Instead, this potential could be more efficiently utilised in bioenergy systems to supply heat and power for the agro-industrial and rural residential sectors. Because of its large coffee agro-industry, ranking 3rd in the global coffee production, Colombia generates a significant amount of different residues along the coffee cultivation-processing chain. This is the case of coffee stems, a coffee crop residue with a lignocellulosic composition and calorific value that makes them a suitable solid fuel for thermochemical conversion processes.

This research carries out a comprehensive assessment of the feasibility of using coffee stems in small-scale gasification systems to produce a gas fit for injection in internal combustion engines (ICE) for power generation. The option of recovering the low-grade heat produced by the system to supply external/internal heat demands is also explored. The characteristics of the gas (heating value) and of the gasifier (gas yield and cold-gas efficiency) show that the producer gas could be utilised in ICE devices for power generation. The overall system efficiency (> 45%) also indicates that the deployment of these systems could be technically feasible; and that the recovery of the low-grade heat positively influences the global efficiency and the relevance of using these systems in the Colombian coffee sector.

An analysis of the energy demand and coffee stems availability of the sector also shows that medium-to-large scale coffee farms are the most appropriate scale at which these systems could be deployed and operate. At this scale, the biomass demand could be provided on a regular basis and the electricity and partial heat demand for coffee drying could be potentially delivered by the gasifier-ICE system. From a life-cycle analysis perspective, the feasibility of generating low-

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carbon energy through coffee stems gasification is mainly determined by the current practices that could be potentially displaced by the bioenergy system. Environmental trade-offs would need to be considered when the substitution of the existing power generation derives from the Colombian on-grid power system, as it is characterised by a relatively low-carbon footprint, as a result of the high share of hydropower.

Education for Sustainability

Soraya El-Deir
Federal Rural University of Pernambuco
Brazil

From the Industrial Revolution onwards, the manufactured production system was transformed with the use of machines, initially in the weaving and transport industry, through the use of coal and, later, of electricity as an energy source. Education was directed to this economic and social reality and, in large part, to the understanding of the use of technologies aimed at increasing the efficiency of the productive system. In what is conventionally called traditional education, teaching is focused on contents that are identified in the syllabus of the discipline, which should be taught to the student. There is a disconnect with the reality of the student and society. Today, working with emerging concepts (cleaner production, sustainability, industrial ecology, ...), what are the challenges facing the education system in order to discuss and deepen knowledge about the Sustainable Development Goals?

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Conferences and Oral Presentations 22nd June 2018

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22nd June 2018

8h00-9h40	Session 6A	Room 1
The Role of Solar Energy in the Climate Change Mitigation and Adaptation: Perspectives for Brazil 2030		
Assessment and Management of the Carbon Footprint in the Research Center Santa Lucia (UNIPAZ) (Barrancabermeja, Santander)		
Brazilian Public Policy for Environment: focus on conservation units and greenhouse gases emission in the Center-West Region		
Application of the Norm NTC-ISO 14064 at ITM Campus Robledo, for Greenhouse Gases (GHG) Emission Measurement and its Carbon Footprint (CF) Determination		
Carbon footprint of commercial forest plantations (<i>Eucalyptus grandis</i> , <i>Pinus patula</i>) and protection forest plantation (<i>Guadua angustifolia kunth</i>) in Colombia		

The Role of Solar Energy in the Climate Change Mitigation and Adaptation: Perspectives for Brazil 2030

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Abstract

This article aims to analyze the possible contributions of solar energy (renewable source), associated with food, water and energy security, as part of the adaptation and mitigation agenda to minimise the negative impacts caused by Climate changes that are part of Brazil's determined national contribution (NDC) to the Paris agreement. The methodological procedures adopted in this work were: bibliographical and exploratory research: a) bibliography, researched books and articles dealing with the Nexus (AN) approach; b) Exploratory, analyzed Brazilian energy planning documents for 2030, in particular renewable sources (solar energy), National Energy Plan (PNE), determined national contribution (NDC) and analysis of 2 (two) cases, being: 1 (one) of energy Solar in residences (houses and apartments) of my Home program My Life (MCMV) and 1 (one) solar power case in small rural properties. The study demonstrates as a result: Case 1-MCMV and MRV enterprises with solar energy kit and case 2-solar energy in small rural properties, presents a strong correlation with the strategies of adaptation and mitigation to the vulnerabilities to the changes Climate. As for the synergy with food security, hydro and energy, Case 1 shows that it has low synergy with water, high with energy and medium with food; Case 2 presents high synergy with water, energy and food. The study is scientifically relevant because it sought to analyze cases that combine the strategies of adaptation and mitigation to the vulnerabilities caused by climate change.

Keywords: *Climate change, renewable energy, mitigation and adaptation.*

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Assessment and Management of the Carbon Footprint in the Research Center Santa Lucia (UNIPAZ) (Barrancabermeja, Santander)

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Abstract

The investigation was made in the Center of Investigation of Santa Lucía (CISL) in the University Institute of Peace (UNIPAZ), in order to create the baseline of its main sources of Greenhouse Gas (GHG) Emissions (Methane, Carbon dioxide, Carbon monoxide, oxides of Sulfur and Nitrogen, etc.) generated directly (by use of fossil fuels and generation of animal faeces) and indirectly (by consumption of electrical energy) and to establish the level of atmospheric affectation, by means of the estimation of the carbon footprint (CF) under the Life cycle Analysis "LCA " method , according to the norm NTC-ISO 14040/14044 of 2006 (Software SIMAPRO 7.1®, IMPACT 2002 evaluation method) and NTC-ISO 14067 of 2013 (IPCC GWP method). The scope of the environmental assessment contemplated the energy consumption required during a month of academic activities (by 1.941 individuals) in the different areas: administrative (offices), library (library, auditoriums, systems rooms, cafeterias), external area (agricultural sector), public lighting, nursing), building of classrooms, power plants, combustion of ACPM in transport and generation of faeces (porcine, bovine, equine and poultry). The baseline was made from the collection of information through surveys, field visits and validation with bibliographic references, where the quantification of the global energy consumption associated with the use of electrical and electronic equipment was determined (2.75491,53 MJ/month), as well as the use of ACPM fuel for the personnel mobilization (5.282,39 gal/month) and finally the generation of feces (64,80 kg / day) for all the evaluated species. According to the environmental analysis obtained by the IPCC GWP method, over time the total effect of the power of global warming (225.109 kg CO2 eq) in periods of 20 years was estimated (impact of 55%, equivalent to 124.815 kg CO2 eq.), 100 years (impact of 28%, equivalent to 61.833 kg CO2 eq.) and 500 years (impact of 17%, equivalent to 38460 kg CO2 eq.). The monthly Carbon Footprint estimated by the CISL was 31.983,14 kg CO2 eq, equivalent to a monthly per capita of 15.07 kg CO2 eq, which means that the CISL has greater CO2 absorption capacity through the native forests and sown, that the same emission that is generated (> 97% approximately). When comparing the value obtained by the UNIPAZ, with the CF per capita in Colombia (141,7 kg CO2 eq), it is clear that the per capita emission generated by the CISL is much lower, because the activities carried out within the facilities of the campus are different and of shorter duration than those commonly done in the home.

Keywords: *Carbon footprint, life cycle analysis, greenhouse gases, potential environmental impact.*

Brazilian Public Policy for Environment: Focus on Conservation Units and Greenhouse Gases Emission in the Center-West Region

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Abstract

Currently, it is possible to identify groups with distinct interests in relation to the use of the land in Brazil. On the one hand, there are individuals endowed with the approach of obtaining the maximization of extensive agricultural production and, on the other hand, those agents who care for the biodiversity conservation of the biomes. The objective of this paper is to identify the emissions of greenhouse gases from the Center-West Region of Brazil, especially those related to land use change and greenhouse gas mitigation, from conservation units in the same region. Therefore, descriptive statistics and the correlation among the variables were used. Among the identified results, it is observed that the conservation units allow CO₂ emission reductions in the region and, considering climate changes, there should be a stimulus for the creation of these units, but this area delimitation should be carried out after discussions with the local community. However, it is not the only measure that can contribute to the reduction of the problem, changes in the production process can bring other contributions and changes in the volume of consumption of the products and services produced.

Keywords: *climate change; environment and mitigation of greenhouse gases.*

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Application of the Norm NTC-ISO 14064 at ITM Campus Robledo, for Greenhouse Gases (GHG) Emission Measurement and its Carbon Footprint (CF) Determination

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Abstract

The present work contains the result of the Carbon Footprint (CF) measurement of the Metropolitan Technological Institute of Medellín (ITM), which is a public institution that provides teaching, research and extension services. The calculation of this sustainability indicator was made for Robledo campus, in accordance with the methodology described in ISO 14064 (Greenhouse Gases Measurement), ISO 14040-14044 (Life Cycle Analysis), and the information provided by the Institution and endorsed by the different dependencies of its consumptions of materials and energy resources, necessary for its correct operation. Additionally, the data of conversion and emission factors associated to the Colombian context or subtracted from the literature are considered, being these the most approximate to the current technical, economic, social and environmental conditions of ITM. According to implemented methodology, the ITM carbon footprint for 2.016 was 912,302 Ton CO₂eq and per student was 0,0925 Ton CO₂eq /Student

Keywords: *Greenhouse Gases, Carbon Footprint, Life Cycle Assessment, Sustainability, University.*

Carbon Footprint of Commercial Forest Plantations (*Eucalyptus grandis*, *Pinus patula*) and Protection Forest Plantation (*Guadua angustifolia kunth*) in Colombia

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Abstract

Life cycle analysis (LCA) is a criterion to identify and quantify environmental benefits for process or products. LCA is useful to determine different environmental impact categories in the whole production chain or part of it. Carbon dioxide mitigation improves the global environmental impact of a specific product expressed as carbon footprint by the substitution of raw materials and processes to combine environmental and economic benefits. In this work, LCA was performed to determine the carbon footprint for two commercial forest plantations (*Eucalyptus grandis*, *Pinus patula*) and one protection forest (*Guadua angustifolia kunth*) in Colombia. Forestry operations were divided into three categories: seedlings production, planting and soil preparation, and maintenance and control. The felling process was not considered. The amount of plants per hectare was established for each species. The OpenLCA® software was used to evaluate emissions in global warming potential, and the Ecoinvent v3.2 database for the inputs of life cycle inventory data for different secondary processes. The inputs that feed the forestry processes were obtained from the management and commercial forestry plans for the evaluated species. Results showed that the variations depend on species planted and their maintenance, which includes different levels of fertilization, as well as different intensity of forestry operations. The maintenance and control stage have the highest contribution to total emissions of CO₂, being a considerable result that counteracts the CO₂ captured by the plantations.

Keywords: carbon footprint, life cycling analysis, OpenLCA

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22nd June 2018

8h00-9h40	Session 6A	Room 2
Lean Six Sigma and Sustainability: Literature Review Analysis		
Global Reporting Initiative's Sustainability Report: What Does It Really Indicates?		
Colombian Oil Market: Keys to Sustainable Development		
Mapping Drivers and Inhibitors Factors for the Integration of Stakeholders in the Development of Green Products Innovation		

Lean Six Sigma and Sustainability: Literature Review Analysis

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Abstract

Lean Six Sigma (LSS) has contributed to many organizations around the world to adopt this in their operations to become more competitive. The evolution of production systems and government requirements has led companies to develop strategies to achieve more sustainable operations. Evidences suggest that LSS and sustainability (LSSS) contribute to organization performance and environmental issues. However, the theoretical contribution from LSSS has been insufficiently discussed in literature. This article aims to analyze articles on literature reviews on the LSSS theme, in order to present its main characteristics. This study verifies what has been published on the theme in order to point out similarities and differences in research findings. Additionally, there is a comparison on what has been discussed in LSS literature reviews to what is available in LSSS literature reviews. The results show that there are few publications on LSSS. Even so, there are similarities in research findings among LSS and LSSS literature reviews, which can lead to many research opportunities in the theme.

Keywords: *Lean Six Sigma, Sustainability, and literature review.*

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Global Reporting Initiative's Sustainability Report: What Does It Really Indicates?

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Abstract

The growing number of stakeholders that consider aspects of sustainability in their decisions requires larger amount and quality of information. In this sense, the Global Reporting Initiative (GRI) proposed a standard to disclose sustainability aspects of companies, named sustainability report. The use of GRI standards by companies has been growing worldwide and it is considered a step forward in the search for sustainability. Companies that disclose sustainability aspects based on the GRI standards are being labeled as sustainable, and generally they achieve benefits compared to those ones that do not belong to GRI. Although considered a positive approach towards companies sustainability, the GRI does not has a metric or scientific approach in calculating quantitative sustainability indicators, which raises doubts about the sustainability degree for those GRI companies. This work evaluates comparatively the performance of companies that belong to the GRI with the sustainability indicator based on the input-output thermodynamic analysis (YLR). One representative company from the 33 economic sectors was considered as case study. Surveys were applied to experts in sustainability, and the content analysis method was used to quantify the existing information in the GRI reports. Results show a non-correlation between GRI G4 and YLR, because the Pearson and Spearman coefficients obtained were -0.167 and 0.193 respectively; this indicates a non-linear correlation and non-similar classification between GRI G4 and YLR. The obtained results highlights that GRI companies are not, mandatorily, synonyms of sustainable companies. Sustainability reports as the one supported by GRI are important alternatives and should be promoted, but the GRI developers could demand for quantitative aspects into the reports, mainly those aspects related to resource usage and waste generation by companies.

Keywords: *GRI, Sustainability, Sustainability Report, TIOA*

Colombian Oil Market: Keys to Sustainable Development

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Abstract

This paper analyzes the conceptual and methodological relevance of the ten features of successful proposed for the design of an energy market, which was used to recognize drivers, barriers and / or inhibitors in the Colombian oil market. The design involved the analysis of the costs associated with the projects, a list of the ten features that can support the recognition of ideas for the Colombian context and the proposal of recommendations that are the basis for the generation of sustainable policies. These recommendations are designed with a comprehensive view, which allows strengthening the decision making from the different points of view under which they are put on trial. The results show that the integration of policies for sustainable development must consider public and private actors, to give a greater scope that can strengthen the improvement in decision making and the quality of the processes.

Keywords: *energy market; sustainability; energy policy; Oil&Gas; self-sufficiency*

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Mapping Drivers and Inhibitors Factors for the Integration of Stakeholders in the Development of Green Products Innovation

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Abstract

The present study aimed, through a systematic review of the literature, identify drivers and inhibitors for the integration of stakeholders in the developing process of environmentally sustainable products. From the 37 articles selected, it was mapped that both internal and external resources tend to facilitate or hinder the process of integration and collaboration between companies and stakeholders in the development of green product innovations. The main drivers are the variables "joint development of resources and capacities", "competitive advantage", "non-linearity of processes", "market and stakeholder pressures", "organizational learning" and "commitment of managements". As for the inhibitors, "knowledge socialization", "initial costs" and "trust" are the variables with the highest frequency of citation in the articles analyzed. In addition to the listing factors, the article summarizes micro, meso and macroenvironment variables, relevant for implementation of integration and collaboration practices between company and stakeholders.

Keywords: *Cross-functional collaboration; Sustainability; Product development; Eco-innovation.*

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“CLEANER PRODUCTION FOR ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS”

Barranquilla – Colombia – June 21st - 22nd - 2018

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.*

22nd June 2018

8h00-9h40	Session 6A	Room 3
Study of temperature effect on Blue Methylene dye bio-removal process by <i>Galactomyces geotrichum</i> KL20A		
Development of Biosorbents from Canola Biomass to Pb2+ Removal		
Environmental and Economic Assessment of the Adoption of Cleaner Production in Textile Spinning Process		
Degree of Maturity of Management and Environmental Practices: Study of Companies in the Sector of Footwear Components		
Upcycling as an Alternative to a Sustainable Fashion		

Study of Temperature Effect on Blue Methylene dye Bio-Removal Process by *Galactomyces geotrichum* KL20A

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Abstract

Pollution of natural resources is a topic of growing global attention, last years different activities have increased consumption of a variety of substances which they are toxic to the environment, recalcitrant and hard to removal. Among these substances, dyes affect the quality of the water and are used in a wide range of industrial activities such as the textile. These dyes are undesirable to the environment, due to their toxicity and mutagenic risk, in addition, they cause changes in pH, salinity, increase dissolved organic carbon (DOC), total organic carbon (TOC), chemical oxygen demand (COD), biochemical demand of oxygen (BOD), they also reduce water transparency affecting the photosynthetic activity and aquatic life.

Different traditional physical-chemical methodologies to pollutant removal have been used for the treatment of dyes (e.g. adsorption, coagulation, precipitation, filtration and oxidation); however, these methods do not solve the problem completely, since they only change phase of pollutant and sometimes could generate by products toxic. Currently, biological processes (e.g. microorganisms and their enzymes) are emerging as one promising technique to bio-removal azo dyes from water sources, since this method not only degrade the dye but it can transform pollutants into harmless products, these byproducts may be integrated to nature biogeochemical cycles and cause less environmental impact. In this work, used a strain of yeast *Galactomyces geotrichum* KL20A isolated from samples of traditional kumis collected from production center in the Valle del Cauca Colombia in order to evaluate their ability to methylene blue dye bio-removal from water samples.

Keywords: *Bio-removal, dyes azo dyes, Galactomyces geotrichum*

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Development of Biosorbents from Canola Biomass to Pb²⁺ Removal

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Abstract

The quality of water is a subject that has been discussed a lot nowadays, mainly regarding the removal of various contaminants of this environmental compartment. Since the importance of this resource it was included into the global objectives of the UN sustainable development - which aiming to asseguarate the sustainable disponibility and management of the water. In this context, the objective of this work was to evaluate the potencial of Pb²⁺ removal of waters through solid waste (pie) of hybrid Hyola 411 canola by adsorption process. In this study four adsorbents were developed, being them: C. *in natura*, which was the precursor of the modified adsorbents (C. H₂O₂, C. H₂SO₄ e C. NaOH). These adsorbents were characterized by MEV, FT-IR, pH_{pzc}, TG/DTG, BET and BJH. It was also realized studies relating the possible interaction between the pH of the Pb²⁺ solution and adsorbent masses, as well as the kinetic (through linear models of pseudo-first order, pseudo-second order, Elovich and intraparticle diffusion) and adsorption equilibrium studies (through linear models of Langmuir, Freundlich and Dubinin-Radushkevich), and some thermodynamic parameters (ΔG , ΔH and ΔS). The obtained results for pseudo-second order suggest the chemical adsorption of Pb²⁺ (Ho & McKay 1999). It was observed a good adjustment for the models of Langmuir and Freundlich suggesting adsorption in mono and in multilayers. The highest values of Q_m and K_f were obtained for C. NaOH. Good adjustment was also observed for D-R with C. NaOH exhibiting value of E > 8, suggesting chemisorption of Pb²⁺. According to the results obtained for thermodynamic studies C. H₂O₂ was the exception among the modifications, showing positive values of ΔH suggesting an endothermic system. The other adsorbents exhibited $\Delta H < 0$, ie., exothermic systems. The values of $\Delta G < 0$ indicate the occurrence of spontaneous adsorption of Pb²⁺. The positive values of ΔS illustrate the increase of disorder and randomness of the solid/solution interface, suggesting the irreversibility of the reaction. In this way, it is concluded that the modified canola with NaOH presents great potential for use in the removal of Pb²⁺ with increase of 2,6 times in the adsorption capacity, representing an excellent environmental and economic alternative for the removal of this toxic element from the environment. The use of these renewable adsorbents can contribute significantly in water treatment systems, besides being a new and important destination for canola agroindustry wastes, thus helping in the development of a sustainable society.

Keywords: *modified adsorbents, toxic metals, contamination, sorption.*

Environmental and Economic Assessment of the Adoption of Cleaner Production in Textile Spinning Process

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Abstract

The energy efficiency and reduced consumption of raw materials in the textile spinning process contribute to the goals to achieve sustainable development in terms of ensure sustainable consumption and production. The aims at developing economic and environmental assessment of the adoption of technological change as a cleaner production action in the textile spinning process. The method adopted was case study and for data collection used interview and observation in two spinning processes in a textile industry. The economic and environmental advantages were calculated based on the reduction of emissions and waste. Used Mass Intensity Factor for environmental analysis. The results measure economic and environmental gains, contributing to the decision-making process of new investments and evidence of optimization of raw materials, reduction of electric energy consumption, intermediate reuse and reduction of waste for disposal that are relevant factors to ensure sustainable consumption and production.

Keywords: *Cleaner production, Sustainable Consumption and Production, technological change, Reduction in energy and raw materials consumption, Textile spinning process*

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Degree of Maturity of Management and Environmental Practices: Study of Companies in the Sector of Footwear Components

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Abstract

Corporate environmental management has become one of the main topics of business strategy, object of studies for the Academy and a necessity for businesses, especially for those who have high environmental impact. This branch of business administration develops in evolutionary stages in organizations, called degrees of maturity of environmental management, and are relevant to the investigation and understanding of the efforts made by business organisations in regard to the environment, assisting the direction and guidance of resources towards achieving environmental excellence. To adjust their operations and solve their difficulties in relation to the environment, organizations adopt environmental practices that may be related to the degree of maturity of environmental management. The research aimed to investigate the degree of maturity of management and environmental practices by evolutionary stages reactive, preventive and proactive components for footwear companies in Rio Grande do Sul, SANTA CATARINA and São Paulo held applied research, with features descriptive, using quantitative approach, accomplished through a survey with a data collection instrument developed for this purpose and applied to a sample of 269 set of industries selected companies, with 28 replies valid. The data were analyzed through correlation analysis to verify relationship between management and environmental practices. The degree of maturity was verified from the score reached on a scale of 1 to 5, measured by the harmonic average of the responses in each block of questions of the instrument, corresponding to the stages of maturity, according to the characteristics of the management Environmental. The results obtained from the analysis indicate that the group of companies obtained scores with the reactive stage with 3.76, the preventive with 4.11 and the proactive with 2.85 points, characterizing the companies in preventive stage with proactive tendency and demonstrating the Permanence of elements of previous evolutionary stages in later. It is important to note that there was significant relationship between the maturity of environmental management (preventative) and environmental practices with a coefficient of correlation ($R = 0,700$), between the maturity of environmental management (proactive) and environmental practices of ($R = 0,771$) To a level of significance less than 5%. In this respect it can be concluded that companies tend to maintain environmental practices characteristics of the previous phases and to increase in new phases the characteristic practices.

Keywords: *Degrees of maturity. Evolutionary stages. Environmental Practices. Environmental management. Sustainability.*

Upcycling as an Alternative to a Sustainable Fashion

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Abstract

In the face of concerns about the future of the planet, new practices are being sought to reinsert products destined to be discarded. Many consumers, worried about environmental degradation, dissatisfied with fast fashion styles, began to question unsustainable consumer practices, such as disposable garments. As a result of this, professionals and scholars in the field of fashion, has been developing different strategies for lifestyle change, and one of them is upcycling. This article aims to analyze the use of upcycling in a fashion company, from a case study of the Handmade Sky brand, which inserted the techniques of upcycling in the development of its products. After all, it has been observed that the disposal is not always the final destination of the products.

Keywords: *sustainability; upcycling; fashion; slow fashion.*

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22nd June 2018

8h00-9h40	Session 6A	Room 4
Sustainability Assessment of Agribusiness Expansion in the Brazilian Savanna		
Agricultural landscape change and land footprint: the case study of Sardinia, Italy		
Emergy Synthesis and Sustainability: Analysis of Emergy Flows in the Territorial Dynamics in the Municipality of Pitalito - Huila		
Optimization Model for the sizing of renewable energy solutions for non-interconnected areas - Case Study in Chocó, Colombia		
Parameters for evaluation of Contaminated Areas: Analysis of Federal Regulations in Brazil and Colombia and Relevance of Air Quality Monitoring		

Sustainability Assessment of Agribusiness Expansion in the Brazilian Savanna

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Abstract

The MATOPIBA region is recognized as the last remaining agricultural area in Brazil. It was legally established by the Brazilian government in 2015 to promote the regional socioeconomic development by means of agribusiness expansion on the savanna region through economic incentives. Although recognizing this strategic approach as a potential alternative to bring regional socioeconomic progress, when not criteriously regulated and monitored, it could also result in negative impacts, mainly on the socio-environmental issues. In this sense, this work aims to assess the degree of sustainability obtained from the expansion of agribusiness on the MATOPIBA. The Input-State-Output (ISO) sustainability conceptual model is considered and supported by three indicators representing each ISO's dimension: emergy (with an "m") for input, human development index (HDI) for state, and gross domestic product (GDP) for the output dimension. Indicators are calculated for the 1991-2015 years' time window. Results indicate an exponential increase for GDP/capita (about 16 times higher for 2015 than 1991), an increase for HDI (about 3 times higher), and a steady-state behavior for resources demanding represented by emergy/capita. These numbers show that agribusiness expansion on MATOPIBA region have resulted in an increase for its sustainability degree, because it is becoming more efficient in converting resources (emergy/capita) into economic wealth (GDP/capita), at the same time improving the life quality (HDI) for its population. This supports that governmental strategic plan for agribusiness on MATOPIBA has reached higher degrees of sustainability for this region and, consequently, this plan should be promoted.

Keywords: *Agribusiness, MATOPIBA, Multicriteria sustainability assessment, Regional sustainability.*

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Agricultural Landscape Change and Land Footprint: The Case Study of Sardinia, Italy

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Abstract

Urban population growth has triggered a process of change in rural areas and landscape patterns. This transformation has a twofold consequence. On one hand, land conversion causes loss of biodiversity and habitat destruction (Deng et al., 2017). On the other hand, higher levels of food demand, together with the reduction of available land, endanger the capability of supplying food at local level. The local food systems and food security is increasingly dependent by trade and transport costs. Local food system conservation is increasingly recognized as a key factor in the pursuit of sustainable and bio based economy perspective. Land food footprint is a significant tool in assessing food self-sufficiency, land displacement and thus food system sustainability. In this paper we analyse the evolution of land food footprint and landscape diversity in Sardinia over the period 1970-2010 to assess the impact of land use change and food systems evolution. Time series show a decrease in landscape diversity and greater degrees of few landscape elements dominance, agricultural specialization and declining self-sufficiency. In summary, these results show that diversified and traditional crops have been replaced by specialised, less labour-intensive crops and that the local food system is integrated by food imports, resulting in land unbalance (land displacement), in landscape features simplification and in rural settlements abandon.

Keywords: *Land food footprint; Landscape diversity; Food planning; Landscape quantitative analysis; Land use.*

Emergy Synthesis and Sustainability: Analysis of Emergy Flows in the Territorial Dynamics in the Municipality of Pitalito - Huila

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Abstract

This work shows the application of emergy synthesis in the municipality of Pitalito a small territory located in the Department of Huila in southwestern Colombia, the purpose of this application is to establish a basis of analysis for the identification of environmental, social and productive relationships in the systems under study, as well as the dynamics of generation, use and exploitation of energy in their processes, analyzing the energy intensity, environmental pressure, the structure of existing resources and the efficiency of their use. The analysis allowed to quantify the primary renewable flows and reserves, the dynamics and effects of productive and extractive activities in the territory, as well as the different interrelationships between flows, energy efficiency and sustainability in the framework of the integration of energy, territory and development -ETD- with a systemic vision, allowing the identification of critical points for the formulation of measures, decision making and policy approaches for territorial sustainable development.

Keywords: *emergy synthesis, sustainability, territory*

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Optimization Model for the Sizing of Renewable Energy Solutions for Non-Interconnected Areas - Case Study in Chocó, Colombia

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-

Abstract

Access to electricity is essential for the economic growth and welfare of every population. Despite this, 15% of the world population does not have access to electricity. In Colombia, 52% of the national territory, where around 2 million people live (5% of the population), is considered non-interconnectable due to its remoteness or difficult access from the main population centers (non-interconnectable zone). The communities that live in non-interconnectable zone are characterized by being extremely poor and have a precarious supplying of electricity needs. This is generally through fossil fuels, which offer a contaminating, intermittent, unreliable and high-cost service for these communities. Currently, renewable energies offer an opportunity for the development of this type of population, because they allow the electricity generation at low cost and in the places of consumption (what is known as distributed generation).

The objective of this research is to develop a tool for energy solutions planning for communities in non-interconnectable zones in order to achieve optimal solutions and evaluate different configurations of electricity generation systems for a community, suggesting both its size and the mix of energy more appropriate to supply the demand with the lowest possible cost. The proposed model allows to consider different mixtures of technologies (renewable, fossils and batteries), the randomness of the climatic variables that are indispensable for renewable energies, such as solar radiation, wind speed and water inputs, and the costs involved.

To test the model, a case study is presented in an isolated community called Playa Potes, located in Bahía Solano, in the department of Chocó, Colombia. The results of the model suggest that the installation of a solar photovoltaic plant of 26 kW, accompanied by a battery bank, would be sufficient to meet the energy needs of the population 24 hours a day and under uncertain climatic conditions, taking into account the cost.

Keywords: *Linear Programming, Rural electrification, Renewable Energies, non-interconnected areas.*

Parameters for Evaluation of Contaminated Areas: Analysis of Federal Regulations in Brazil and Colombia and Relevance of Air Quality Monitoring

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Abstract

The management of Urban Solid Waste remains a great challenge for developing countries due to political, economic and cultural aspects. In the present work, the environmental laws of Brazil and Colombia are assessed regarding the management of contaminated sites and the aspects addressed in them will be compared, focusing on the parameters used for diagnosis, evaluation and monitoring of these areas. Three case studies of biogas monitoring in contaminated areas are presented with aiming to emphasize the relevance and the impact caused in the surroundings of these sites due to old solid waste deposits, since the decomposition of the organic matter present in them generates gases (biogas) that in certain concentrations may pose a risk to human health. Finally, it is recommended that regulatory frameworks in both countries focus not only on soil and groundwater quality control, but also on the control and monitoring of air quality within the scope of actions on contaminated areas management.

Keywords: *Management of contaminated sites Environmental Regulations. Risk. Biogas..*

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22nd June 2018

8h00-9h40	Session 6A	Room 5
Evaluation of the Reverse Logistics Performance in Civil Construction		
Application of the Blockchain Architecture in Solid Waste Management in a Small Municipality		
Economics of the Asphalt-Rubber Application in Urban Paving: A Case Study in Goiânia		
Correlation of management indicators in the sectors of household solid waste collection of the Recife/PE, Brazil		

Evaluation of the Reverse Logistics Performance in Civil Construction

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Abstract

Reverse Logistics is an activity that excels adding value to customers upon returning the consumer product to its origin. This return, when applied to products at the end of its useful life, makes this practice a "green" dimension because it provides an environmentally correct disposal of waste and assists the reuse of material, recycling and remanufacturing. Therefore, the operations performance evaluation arouses interest and acquires relevance. However, this activity is still little practiced in developing countries, such as Brazil and Colombia. It is the purpose of this article, to present a model for the Reverse Logistics performance evaluation in the construction industry - one of the sectors that most generates waste and which has a tremendous economic impact on the nations. The research began with a search in databases for publications concerning the performance evaluation of this practice with the aim to serve the model construction. The search resulted in only one article in the civil construction sector. Thus, it was researched in an exploratory way for studies that would enable the mapping of reverse flows of civil construction in developing countries. From this mapping a model was elaborated with indicators that address the logistics of supplies, internal and reverse, in order to evaluate the companies performance of this sector. A test was performed in a Brazilian construction company and in another Colombian one with the aim to demonstrate its applicability, where it was possible to highlight improvement points for each company and for the model that can be reapplied in other organizations of the sector. Despite the excellent performance presented by companies, it was noticed the lack of attention with this logistics area.

Keywords: *Reverse logistics. Civil construction. Performance evaluation.*

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Application of the Blockchain Architecture in Solid Waste Management in a Small Municipality

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Abstract

This research deals with the application of Blockchain digital architecture in solid waste management in a small municipality in the interior of the state of São Paulo, Brazil.

The ongoing research is related to the technological transformation of a compensation system to the collection of waste in the municipality, aimed at the social inclusion of waste collectors through the use of social currency.

The current system uses printed cards called Green Coins, and present vulnerabilities that should be overcome with the implementation of the new system.

The new application uses social crypto-coins and security support through Blockchain in order to guarantee the necessary information integrity, enabling the management of an expressive number of collectors and contributing to the improvement of the quality of life in the municipality in relation to the typical aspects of sustainability: education, health, environment, social inclusion and local economy.

Keywords: *Blockchain, cryptocurrency, solid waste management; sustainability; social inclusion.*

Economics of the Asphalt-Rubber Application in Urban Paving: A Case Study in Goiânia

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Abstract

Streets and roads in general, so necessary for land transport, become a catalyst for local and regional development when paved. This work evaluates the use of conventional asphalt against rubber asphalt in an economical aspect, with respect to sustainability, showing the economic viability of Modified Rubber Asphalt (AMB) technology adoption. A Case Study on the urban paving of the Jardim do Cerrado III residential neighbor in the city of Goiânia (Goiás) were carried out to discuss the validation of the above hypothesis. The choice of the paving type, by technologically modified asphalt, can minimize economic and environmental damages.

Keywords: *sustainability, urbanization, urban infrastructure, rubber-asphalt*

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Correlation of Management Indicators in the Sectors of Household Solid Waste Collection of the Recife/PE, Brazil

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Abstract

Searching for solutions in solid waste management is a continuous challenge for municipal managers. Faced with the growing scenario of generation of these materials, especially in urban areas, the need to elaborate an integrated, participatory, viable and appropriate management model to the reality of the municipality becomes essential. In this sense, the in-depth study of indicators related to the managerial dynamics of solid wastes is the basis for proposing management models that meet the socioeconomic and environmental characteristics of the region. In this way, the present article studies the correlation of four indicators (population, income, generation and gravimetric composition) in 31 sectors of solid waste collection in the city of Recife, through Principal Component Analysis, in order to identify the indicators defining the realities of the sectors. The results elucidate a strong positive correlation between income and per capita generation of household solid waste (HSW), which is evident in the upper-class areas of the city and in the essentially commercial areas. The identification of indicators of greater influence in the collection sectors will assist the municipal manager in the elaboration of RSD sectorial management models that seek to understand the particular socioeconomic characteristics listed.

Keywords: *Solid Waste Management. Collection Sectors. Management indicators. Principal Component Analysis.*

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22nd June 2018

8h00-9h40	Session 6A	Room 6
<hr/>		
How Can Green Supply Chain Management Contribute to the Product Development Process?		
Electric supply and autonomous system for a cleaner production of pesticide-free aeroponic food products		
Sustainability management of the VHP sugar supply chain: case study in the transportation stage		
Understanding the Reverse Chain Structure of the Glass Bottles in São Paulo		
Social Innovation in the Productive Chain of Brazilian Wine-Process and Results of Innovation		

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.*

How Can Green Supply Chain Management Contribute to the Product Development Process?

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Abstract

The product development process has phases as concept, research, analysis, develop and launch. The supply chain management needs integration with suppliers, manufacturers, and customers. The goal of this study is to link two topics, product development process, and Supply chain management, aiming to understand how this concept join can become more sustainable. To search this answer, it is analyzed the main bibliography references about "product development process" and "green supply chain management". For the literature review development, it was searched at Capes Periodical/MEC, for the concepts of product development process, supply chain, and green supply chain management. The year of publication was not limited, aiming to understand the evolution of all materials already published. The first section is about market demands, laws, regulations and green products. In the second section is discussed green supply chain management and product development process. The second section considers supply chain tiers, like supplier, manufacturer, and customers, all connected with product development process. As results, it was checked that green supply chain management and product development process does not have a consensus, being treated with a broad approach; there is no specific model that orients the companies to develop a product oriented to green supply chain management.

Keywords: green supply chain management, green products, product development process.

Electric Supply and Autonomous System for a Cleaner Production of Pesticide-Free Aeroponic Food Products

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Abstract

Aeroponics allows a more efficient agriculture because the possibility to grow plants in places where conventional open-field agriculture is difficult. The use of technology allows to improve efficiency of the processes, although some energy control and irrigation system solutions must be improved. This paper presents the application of an autonomous power supply and an irrigation control system for the pesticide-free aeroponic food production. The system was designed using Matlab-Simulink-MPLAB tool to perform the control model and to be applied to the crop. Besides, a dsPIC was programmed for the irrigation cycle control algorithms using Matlab-Simulink blocks. The results show that the irrigation cycle and power supply help to maintain uniform plants in the crop, which allows a better development of the aeroponics.

Keywords: *pesticide-free food, aeroponics, autonomous irrigation system, cleaner production, electric power*

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Sustainability Management of the VHP Sugar Supply Chain: Case Study in the Transportation Stage

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Abstract

Concerns about the environmental impacts of sugar production in Brazil opens up space for the development of research on Supply Chain Sustainability Management (SCSM). This work report uses Life Cycle Assessment (LCA) and multi-objective optimization (MOO) methods, especially in the transport phase of very high polarization (VHP) sugar, in order to perform an environmental and economic performance evaluation, for two scenarios, using a case study involving a linear programming problem. In the first scenario, the transportation is carried out only by the road modal, in the second scenario the transportation is intermodal, where a portion of the route was a railroad. With regard to the evaluation of environmental impacts, for the case study, input data regarding the equivalent CO₂ emission were used. For the economic performance indicator, primary data from a Brazilian sugar mills and background data obtained through national reports, manuals and databases were used. Based on the methodology used applying MOO to minimize cost, the model provided optimal cost and CO₂ emissions solutions for scenario one, of 5.72x10¹⁰ kg of CO₂ and cost of USD 33,216, respectively. Scenario two shows an improvement in environmental performance, reducing CO₂ emissions to 1.51x10⁹ kg of CO₂, but increasing costs to USD 98,555. The results of the scenario showed that the railroads may bring relevant environmental benefits, such as of reducing the emission of greenhouse gases, but an alternative little explored in Brazil.

Keywords: *linear programming, multi-objective optimization, life cycle assessment, sugar cane, VHP sugar.*

Understanding the Reverse Chain Structure of the Glass Bottles in São Paulo

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Abstract

The study analyzes the structure of glass bottles reverse logistics in Sao Paulo city, using the decision framework proposed by de Brito e Dekker (2002) outlining the questions how, why and what reverse logistics happen. The study used primary and secondary data to construct the scheme of the structure and understand the operational of the dynamic. There are multiple stakeholders, highlighting the big presence of the informal sector represented by the waste pickers organizations and the bottle pickers. There are additional elements present in some glass bottles, that are not projected to disassembly and are considered as impurities by the customers. The removal of such elements makes the pre-processing more difficult. In brazil, there are enough instruments to regulate the responsibilities of the manufacturers, distributors and merchants. We outline that the main barriers of the reverse logistics in the case of the glass are due to little cover of the selective waste collection, the laborious handling and pre-processing stages and the lack of economic incentives for the glass recycling market.

Keywords: *reverse logistics, post-consumer package, glass, recycle*

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Social Innovation in the Productive Chain of Brazilian Wine-Process and Results of Innovation

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Abstract

Social innovation and your application has a growing interest by different organizations and by scholars, because it provides evidence for decision-making of managers, entrepreneurs, public authorities and other stakeholders of a productive chain. Decisions that seek to find innovative solutions to business problems and of the community as a whole. The challenge is in how to get the data in an organized fashion and punctual, but also take advantage of the potential of the same so that can enhance the way the actors of a productive chain make decisions and develop new pipelines to the development of social innovation. This mapping of the process it is necessary to provide a range of social good and sustainable change benefiting the production chain. Thus sought with this research demonstrate the innovations in wine production chain from RS with the use of the byproducts and the Interchain dynamic capabilities. So, it is necessary to institutionalize innovation through the identification of dynamic capabilities and your better use, to achieve the social good and sustainable change. Interviews with actors of the chain were analyzed by combining the results with insights of different actors involved in the process of social innovation. It was noted that the innovations by developing prototype applications that clearly demonstrate the impact of innovations in all links in the wine production chain, as well as pharmaceutical and Merrymaking chain, having the benefits of innovation from vendors farmers of the region extending to the final consumer.

Keywords: *social innovation, supply chain, process of social innovation, Serra Gaúcha.*

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22nd June 2018

8h00-9h40	Session 6A	Room 7
Business Results of Eco-Innovation in Emerging and Developed Economies		
Design for Environment: framework with theoretical and empirical practices		
Application of Strategy Planning Method to Integrated Development Sustainable Product Process (PEPDIPS)		
Use of Residual Material from the Manufacture of Ceramic Bricks as an Alternative to Improve Soils of High Plasticity Clays		
Carbon Capture and Utilization by Mineral Carbonation with CKD in Aqueous Phase: Experimental Stage and Characterization of Carbonated Products		

Business Results of Eco-Innovation in Emerging and Developed Economies

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Abstract

The article explored 323 sustainability reports certified by the *Global Reporting Initiative*, with the primary aim of assessing – at the company level – the structure of results of eco-innovation at firms established in developed markets and emerging markets in the period from 2012 to 2014. A valid sample of 231 companies was obtained, including 58 from emerging countries and 173 from developed countries. The methodology was based on Structural Equation Modeling and Panel Data Regression. The study found that virtually all environmental and social eco-innovation variables were significant for their respective dimensions in developed countries; however, in the emerging countries, only two environmental and social variables were significant, which shows that there is a more advanced stage of eco-innovation in developed countries. With regard to the results of the panel data regression, the environmental and social variables were significant only for the Return on Sales (ROS), and in a different way between emerging and developed countries.

Keywords: *sustainable innovation, capacity to innovate, performance, emerging economies*

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Design for Environment: Framework with Theoretical and Empirical Practices

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Abstract

Design for Environment (DfE) is a product development technique that contemplates principles of environmental management covering the entire product cycle and can be an opportunity to reduce the environmental impact and to minimize the resources used by a product in its life cycle. In the face of growing pressure from society and governments in organizations for the development of products and services that reduce environmental impacts, the dissemination of DfE practices can facilitate the adoption of environmental practices, thus contributing to product life-cycle management. Theoretical studies on DfE did not show the existence of a systematized set of these practices. Thus, to fill this gap, this study aims to gather DfE practices in a framework. For this, the theoretical practices of DfE were mapped in the literature, by systematic review and, through a case study, DfE practices were identified, empirically observed. After the theoretical-empirical identification, they were analyzed, compared and gathered in a framework that presents the practices classified according to the stages of the product development cycle.

Keywords: *Design for Environment. Theoretical Practices. Empirical practices.*

Application of Strategy Planning Method to Integrated Development Sustainable Product Process (PEPDIPS)

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Abstract

With the reduction of borders promoted by globalization, the level of consumption grew dramatically, characterizing our consumer society. However, if on the one hand this growth means progress, on the other hand, this means progress without a future, since consumption can only symbolize progress if it occurs within a form of sustainable development. Faced with this scenario, society and government have been pushing the industries to adopt more sustainable practices in their processes, especially the Product Development Process (PDP). In this new perspective, the PDP with sustainable characteristics can add a long-term competitive advantage to the company. Therefore, the present study presents the application of the conceptual method for the Strategic Planning of the Integrated Process for the Development of Sustainable Products (PEPDIPS), which aims to guide the integration of sustainability in the PDP through the qualitative evaluation of the requirements and phases of the PDP, from the initial phase of designing the project for the launch and distribution of the product. The PEPDIPS is characterized as a maturation method composed of a cyclic process with two macro phases and four micro phases. With the objective of developing a support evaluation focused on the process of continuous improvement that aims to integrate sustainability into the PDP, guiding the designers the best strategic choices applied in the planning and elaboration of a new or existing product. Extending your assessment to business management, necessary to structure and substantiate such changes. The application of the PEPDIPS method is presented through the case study developed in a textile industry.

Keywords: *Maturity Model, Sustainability, Strategic Planning, Product Development Process.*

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.

Use of Residual Material from the Manufacture of Ceramic Bricks as an Alternative to Improve Soils of High Plasticity Clays

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Abstract

At 2017 Colombia produced an estimated 350,000 tons of bricks per month, the manufacturing process of this product, in addition to generating large amounts of pollution, has a certain percentage of waste, which varies with respect to the level of technification of the brick factory, this Residue in general constitutes an environmental liability and the objective of this work was to study the implementation of the crushed waste from brick manufacturing, as a stabilizing agent of clay soils of high plasticity. The physical and mechanical properties of the waste material were studied, when it was included in the soil mass in proportions of 5%, 10% and 15% by weight, the results indicated a considerable increase in soil resistance, expressed in the value of the soil. CBR that went from 6.7% in natural state to 12.7% for the mixture of 15%, and a reduction in the plasticity index of 23.18% with respect to the natural condition. These values indicate that the use of waste material for the stabilization of soil with problems associated with high plasticity, constitute a viable and environmentally friendly alternative.

Keywords: *Residue, Alternative material, Plasticity, Stabilization, Ceramic brick.*

Carbon Capture and Utilization by Mineral Carbonation with CKD in Aqueous Phase: Experimental Stage and Characterization of Carbonated Products

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Abstract

Carbon dioxide capture and reuse techniques are being developed to reduce greenhouse gas (GHG) emissions from the industrial sector at the same time that high added value by-products are obtained. Carbon capture by mineral carbonation of CO₂ using industrial waste is an interesting technology. Its rate and effectiveness depends on four main parameters: water content of the sample (or amount of mixed water or liquid/solid ratio), particle size, temperature, and pressure. Cement kiln dust, which is a residue of the cement industry, could be considered the most suitable material for this purpose, with a high calcium and magnesium content. We used a response-surface experimental design model to assess CO₂ carbonation mineral techniques and determine its uptake potential, and the products' physical-chemical and mineralogical properties. Diffractogram showed that a carbonated phase was formed after the reaction, increasing the amount of calcium and magnesium carbonates. Theoretical uptake was calculated as 23.4% w/t, instead, experimental yield was found out between 7-22% compared to the theoretically amount of CO₂ sequestration.

Keywords: *carbon capture and utilization, cement kiln dust, industrial waste, mineral carbonation.*

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22nd June 2018

8h00-9h40	Session 6A	Room 8
Wind-speed modelling using Fourier analysis and Nonlinear autoregressive neural network (NAR)		
Thermogravimetric investigation of hydrogen sulphide adsorption in MOF's 1,3,5 BTC		
Fuzzy Logic Controller of Voltage for a Permanent Magnet Wind Generator		
Study of Potential for Energy Recovery in Low-Cylinder Diesel Engines and its Environmental Impact		
Analysis of the Life Cycle of the Bioethanol Production of the Sugar Cane. Case Study: Ingenio		

Wind-Speed Modelling Using Fourier Analysis and Nonlinear Autoregressive Neural Network (NAR)

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Abstract

This paper presents a methodology for analyzing and predicting local wind-speed with high time resolution (hourly) and long-term (years) horizon, through Fourier analysis and Nonlinear autoregressive network (NAR). Engineering activities and wind energy applications (wind power estimation and power system operations) requires accurate wind-speed modelling. Additionally, wind time series exhibits nonlinearities, gaps and scarce of *in situ* data, therefore, the proposed methodology is able to deal with those requirements. Considering the lack of *in situ* data, the research recommends a data assimilation and natural variability identification before atmospheric variable forecasting. The study used a wind-speed time series from the North American Regional Reanalysis (NARR) project database (1980 to 2014) and compared against *in situ* data for assimilation. Then, Fourier identified natural variability for wind-speed at local stations. Also, we found a quarterly variability associated with Madden Julian fluctuations, semiannual, annual, and 6-year variability (ENSO). NAR model predicted successfully the wind-speed with 3 hours' interval for 11 years according to 0.90 of correlation. The low computational cost and the accuracy of modelled results obtained in this research, allow to implement the proposed methodology for diverse engineering and scientific research applications.

Keywords: *wind-speed, Fourier, NAR, reanalysis, wind potential, modelling.*

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.

Thermogravimetric Investigation of Hydrogen Sulphide Adsorption in MOF's 1,3,5 BTC

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Abstract

The metal-based molecular structures, also known as MOF (Metal Organic Frameworks), constitute a class of compounds that has gained importance in the literature, due to the better understanding of the properties of nanocomposites and the relative increase of potentiality of use. In this work are presented results of experiments with MOF based on Fe, Cu, Cd, Al, Pb and Zn prepared with the 1,3,5 benzene tricarboxylic acid binder (BTC). Analogic thermogravimetry experiments were carried out, aiming at elements that allow the evaluation of the potential use of these MOFs (Metal-BTC) for the storage of energy through adsorption of hydrogen sulphide. Acid present in the decomposition of organic compounds, for example in Urban Solid Waste or in oil wells. The results of the analogic thermogravimetric study were obtained by the loss of mass of the material saturated with H₂S. Based on the results, two different aspects can be considered: the adsorption energy of the MOF Metal-H₂S and the question of the micro and nanoscopic morphology of the studied material, since one must interfere in the "permission" of liberation and the other in the kinetics.

Keywords: MOF. Thermogravimetry. Urban Solids Waste. Energy storage.

Fuzzy Logic Controller of Voltage for a Permanent Magnet Wind Generator

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Abstract

In this article, a fuzzy logic controller of voltage is designed to perform the battery charge control, increasing the useful life of the battery, ensuring that the voltage of the three-phase permanent magnet wind generator (PMWG)-rectifier system is improved. The use of clean energies has become more common in our environment due to the low contamination that these systems present, such as wind generation systems. The design and simulation of a controller is done through the fuzzy tool box of the Matlab, a controller in fuzzy logic for a permanent magnets wind generator. With the simulation we can observe the behavior of the controller at different disturbance signals.

Keywords: *Clean energy, fuzzy logic, PM wind generator, wind energy.*

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Study of Potential for Energy Recovery in Low-Cylinder Diesel Engines and its Environmental Impact

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Abstract

This study of thermoelectric generators as an energy recovery system in exhaust gases is a constant research challenge. In this paper, the theoretical model that describes the behavior of the thermoelectric modules is exposed and the CFD simulation results across of ANSYS® software too, where the heat exchanger allows improving the efficiency of the modules increasing the transmitted heat and the surface temperature of hot focus, showing the temperature profile of heat exchanger in contact with exhaust gases and the electric potential of modules in the specific temperature. Also, the influence in the decrease of fuel consumption is evaluated and the environmental impact in the decrease of polluting emissions to the atmosphere.

Keywords: *Thermoelectric module, simulation, heat exchanger, fuel, polluting emissions.*

Analysis of the Life Cycle of the Bioethanol Production of the Sugar Cane. Case Study: Ingenio Risaralda S.A.

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Abstract

The cultivation of sugarcane *Sacharum officinaru*, was introduced to Colombia in the fifteenth century, and due to the country's climate it has the advantage that it can be grown throughout the year. The Sugar Bioindustrial Cluster is located in the geographical valley of the Cauca River (Colombia). This productive sector was industrialized with its core business the specialization in the process of sugar production and then expanding its industrial activity to the production of biofuels (ethanol fuel) and to the generation of electricity. The main objectives for the sustainability of the sector are to seek the reduction of fossil fuel use in the world and the reduction of greenhouse gas emissions. This work presents the results of the analysis of potential environmental impacts of the bioethanol produced at Ingenio Risaralda SA, based on Life Cycle Analysis (LCA) methodology. To obtain the results, the LCA stages were examined following ISO 14040 standard. Among these stages, the Life Cycle Inventory (LCI) phase was the most demanding, because it is the field data collection phase and its subsequent structuring for the LCA. With the inventory completed, the LCI information was introduced in SimaPro software, version 8.2.3. For the environmental impact analysis, the project focused on the ReCiPe Midpoint (H) method, which evaluates 18 impact categories. The system studied includes the bioethanol supply chain at the Ingenio Risaralda S.A. at the field, harvest, factory, distillery and electricity cogeneration phases. It was found that the field phase is responsible for 4 of the 18 impact categories; that harvest phase contributes to 5 of the 18; the factory phase is responsible for 7 of the 18; the distillery phase contributes to 2 of the 18, and the cogeneration phase implies a positive environmental impact in the climate change category, since it uses the energy in the form of heat produced by the bagasse to generate steam and then through the use of turbogenerators to electric energy. For 2015, the calculated emissions from the bioethanol production of sugar cane at Ingenio Risaralda S.A., were of 138 kg CO₂ eq / m³. This result is very good when compared to the data obtained by the climate change studies of the Sugar Cane Research Center (CENICAÑA) which for 2010 was 909 kg CO₂ eq / m³ and for 2015 was 476 kg CO₂ eq / m³. The Ingenio Risaralda S.A. study showed an environmentally clean behavior, due to the non-use of coal in its heaters and boilers, besides it was assumed that the cogenerated energy sold to external customers was environmentally beneficial.

Keywords: *sugarcane; bioethanol; Life cycle analysis; SimaPro software; potential environmental impacts.*

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22nd June 2018

10h00 -12h00	Workshops
	Room 01: Responsible Consumption and Production
	Room 02: Climate Action and Affordable Clean Energy
	Room 03: Sustainable Cities and Communities
	Room 04: Industry Innovation and Infrastructure

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22nd June 2018

13h30 -15h00

**Special Conference - ACPN Medal
Award - Young Researcher**

Gengyuan Liu

**Beijing Normal University -
China**

Managing the Food-Energy-Water
Nexus for Achieving the Urban
Sustainable Development Goals
in China

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.*

Managing the Food-Energy-Water Nexus for Achieving the Urban Sustainable Development Goals in China

Gengyuan Liu

Beijing Normal University - China

One of the 17 sustainable development goals (goal 13) adopted by the United Nations on According to the report of United Nations (2014), the current average urbanization rate has reached 54%, while in 2050, it will become 66%. With the speeding up of urbanization and industrialization, the cities in China have developed fast as well. In the last 30 years, the urban population in China raised from less than 200 million to 700 million rapidly. Nowadays more than half of all the Chinese people live in urban areas. Urban areas consume 26% freshwater, 67~76% energy of all the consumption globally; while emit 75% greenhouse gases. Cities will face numerous problems in meeting the increasing needs of their urban populations. Among these problems, the efficient provision of food, energy, and water is particularly challenging. This is not only because they are essential resources for meeting basic human needs, but also due to the complex interconnectedness of the food, energy, and water systems. Policy and technology solutions addressing challenges in individual FEW systems need to be evaluated through the lens of FEW nexus to identify co-benefits and avoid unintended consequences. Thus, figuring out the multi-resources constraint (FEW) and the coupling relationship of FEW in cities is the top priority for solving the problems of urban development formation as well as a necessary prerequisite for sustainable urban development.

Energy, water and food are related closely, thus study them under one framework will contribute to finding the directions and strength of interactions

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among them, while avoiding the adverse impacts caused by the policy about one factor to another one. The evaluation ways before is only from the perspective of production, which induces the inefficiency of the command of the whole production chains from above as the consumption of FEW in cities are closely related with production chains and trade.

Therefore, this study constructed a step-by-step nesting model for FEW of cities, which made the open urban economic system expand gradually to the state and global economic systems. From both the production and consumption perspectives, the sources and whereabouts of urban implied FEW on state and global scales were clearly figured out; the relationship of FEW with the basis of the exchanges of products and services for cities with other areas were explored; the balance of FEW of cities and the relative dependency for cities with other areas were evaluated and analyzed after the construction of balance and relative-balance factors. This innovative approaches to model the urban food-energy-water nexus as an integrated whole, instead of examining them individually, for sustainable provision of food, energy, and water in urban areas with improved efficiency.

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.*

22nd June 2018

15h00-16h30	Session 6B	Room 1
	Establishment of energy-production and environmental indicators in the physical refinery area of a Colombian food company	
	Evaluation of the Potential Environmental Impacts Generated in the Production of Chicken (Meat) Using the Methodology of Life Cycle Analysis "LCA" by Attributes from Door to Door	
	Application of Goal Programming in Sustainability Studies: Soybean Transportation in Brazil	
	Sustainable Development Goals Index: considerations of Mercosur countries	
	Life Cycle Management for Plastic Waste Management: A Life Cycle Assessment of Polyethylene Bag in Thailand	

Establishment of Energy-Production and Environmental Indicators in the Physical Refinery Area of a Colombian Food Company

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Abstract

This paper presents the results of the application of the strategic decision stage for the implementation of an Integrated Energy Management System, based on the NTC ISO 50,001:2011 standard, in the physical refinery area of a company in the food area, a vegetable oil and grease producer located in Colombia. The principles for obtaining control charts and consumption indexes are shown as a complement to the implementation of the equivalent production method to obtain the base and target lines in terms of natural gas and electric energy consumption for the elaboration of its products from three different raw materials: palm, soybean and sunflower. Through the analysis of each of these graphs, some representative saving potentials were obtained of 30.7, 31.37 and 50.4% in electricity, for soybean, palm and sunflower, respectively, and 23.10, 22.7 and 45% in natural gas in the same order above. These savings are reflected also in the equivalent reduction of CO₂ emissions with an average of 670.43 CO_{2Eq} annually, where 229.7 tons of CO₂ correspond to savings in the physical refinery area due to electrical energy saving consumption and 430.73 tons of CO₂ refer to the impact of reducing the consumption of natural gas.

Keywords: *Energy characterization, food area, saving potential, energy performance indicator, CO₂ emissions.*

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Evaluation of the Potential Environmental Impacts Generated in the Production of Chicken (Meat) Using the Methodology of Life Cycle Analysis "LCA" by Attributes from Door to Door

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Abstract

The methodology of Life Cycle Analysis (LCA) according to the typology by attributes, was implemented to the general poultry process (transport of fertile egg and chicken meat, laying hens farm, broilers and / or reproduction farm, Plant of profit or sacrifice, wastewater plant and storage and distribution plant for chicken meat). The purpose of the LCA analysis was to identify, classify and evaluate the potential environmental impacts (PEI) generated in the different unit operations that make up the life cycle of chicken meat in Santander, Colombia. The construction of the inventory was carried out with data from the poultry industry of a confidential nature (consumption of chemicals, natural resources, fuel and the generation of liquid and atmospheric waste) and literature (emissions associated with the generation of chicken manure, consumption of electric energy and fossil fuel). The scope of the LCA includes the evaluation of the PEIs from door to door, and the impacts associated with the consumption of raw materials such as: water, electricity, natural gas, chemical inputs (additives, coagulants, disinfectants, etc.) and the final disposal of waste (liquid, solid and gaseous). The ACV methodology took as reference the Colombian Technical Standards (NTC-ISO 14040 and NTC-ISO 14044), which establish the criteria for the identification and creation of the environmental inventory, the analysis and interpretation of results, all with the help of the tool (SimaPro software 7.1, available version) according to the EDIP evaluation method 2003. The functional unit of production was 1 ton of chicken meat. The consumption of the mass and energy flow was quantified with a calculation base of 1 hour (mass in ton, energy in MJ). From the analysis obtained, alternatives were proposed to improve the process under study. The processes that contributed most to the generation of environmental impacts were in a 50.84% Reproductive farm associated with the consumption of energy and chemical inputs, followed by the Incubation plant (27.16%), the storage and distribution area (10.63%), the benefit plant (8.93%), the fattening farm (1.71%) and finally the transportation by 0.73%. An analysis was carried out based on a modification of the overall process, which consisted in suppressing the housing subprocess (laying hens) that contributed an environmental contribution of 47.1% (88% of 53.4%), as a result of the energy consumption in the Reproduction Plant; obtaining the following results; the order of maximum energy consumption was obtained by the beneficiation plant, with a percentage of participation of 39.5%, evidenced by the treatment of wastewater generated in the processes by 20% and by the consumption of energy. From the above, the importance of using alternative energies was inferred, as well as controlling the consumption of energy in the different processes that make up the poultry industry.

Keywords: *Life Cycle Analysis, Potential Environmental Impact, Environmental Impact Category, poultry, greenhouse gases.*

Application of Goal Programming in Sustainability Studies: Soybean Transportation in Brazil

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Abstract

Richard Silva et al. (under review) studied the sustainability of road and rail systems in the transport of Brazilian soybeans between producer and exporter centers (1,982 km). For this, the FIVE SEctor Sustainability Model (5 SENSU) was considered. Among ten indicators simultaneously evaluated by the 5 SENSU model, the results indicated greater sustainability for rail transportation. However, due to the multimetric approach used, the graphical interpretation of results can become a difficult task that requires statistical tools as support. In this sense, this work applies the philosophy of goal programming in the results obtained by Richard Silva et al. (under review) to quantitatively assess the sustainability of road and rail soybean transport systems, integrating all the previously obtained indicators into a single global sustainability indicator named as WSI. Results show that rail system has a WSI of 3.47, while road system has 3.55, indicating that rail system is slightly more sustainable. Besides providing subsidies to decision makers on soybean transportation in Brazil, it is expected that this work can be considered as a reference of a multicriteria method in evaluating sustainability for other transport systems.

Keywords: *multicriteria, goal programing, soybean, sustainability, transport.*

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Sustainable Development Goals Index: Considerations of Mercosur Countries

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Abstract

The United Nations Millennium Declaration, in 2000, defined the countries compromise for the promotion of human dignity across the globe and created eight Millennium Development Goals (MDGs). After 15 years, the MDGs have been revised and expanded to 17 Sustainable Development Objectives (SDGs) to be achieved by date of 2030. Thus the United Nations (UN) published a report to follow the goals and developed the SDG Index to apply to 157 countries. Thinking about it, the aim of this study was to understand the results obtained by the SDG Index for the Common Market of the South (Mercosur) countries. The data base and the individual profiles of each country were analyzed. It was possible to verify that from 2015 to 2017 a few Mercosur countries were able to obtain all the targets defined for the SDGs. However, all the nations of this economic bloc have great possibilities to achieve the objective for 2030, because they already have reached 64.7 to 72.5% of goals. This study shows that the greatest challenges in Mercosur countries are related to socio-economic factors, such as adjusted GDP growth, child labor, women in politics, traffic deaths rate, homicide, and corruption perception. It is notice that the environmental factors depend on the solution of these socio-economic problems. The annual accompaniment importance of the goals is evident and public policies of the Mercosur countries should focus on the most critical points and strengthen the positive aspects.

Keywords: *Environmental management. Environmental planning. Indicators. Socio-economic analysis.*

Life Cycle Management for Plastic Waste Management: A Life Cycle Assessment of Polyethylene Bag in Thailand

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Abstract

This study applied life cycle assessment method for the evaluating the environmental impact of post-consumer polyethylene bag for food packaging. The system boundary was defined as the cradle-to-grave which included the production of ethylene, HDPE, LDPE and LLDPE resins and plastic bag, transportation and end-of life management. The results showed that most of environmental impact came from polyethylene resins production and raw material acquisitions including the energy consumption as well. The Strategies for mitigating the environmental impact of polyethylene bag for food packaging in order to achieve sustainability should cover the life cycle management of plastic bag product. For the raw material consumption, bio-materials and recycled plastic resins should be considered for the substitution of virgin material. For the production system, the 3Rs concept should be utilized in all production stages in order to increase the resource efficiency. For the end-of-life management, plastic waste should be recovered as a fuel for the substitution of coal instead of the incineration of municipal solid waste or landfilling method. This option can minimize the impact of global warming and non-carcinogen potential as well.

Keywords: *plastic waste management; 3Rs policy; waste management law and legislation*

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22nd June 2018

15h00-16h30	Session 6B	Room 2
Student Sustainability Assessment: Ecological footprint, happiness and academic performance		
Sustainable Development and Absorptive Capacity: Connecting Themes Through Systematic and Bibliometric Review		
Factors that Influence the Consumption of Organic Foods		
The Meanings of Sustainability: A Comparison Between State and Market Discourses		
Strategies for the Expansion of Environmental Awareness Effects		

Student Sustainability Assessment: Ecological Footprint, Happiness and Academic Performance

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Abstract

Universities can be great drivers of sustainable development. A university can influence students' decisions through knowledge. These students can represent governments, companies and institutions, making important decisions for social progress. In this way, evaluating students' sustainability is important for the decision-making of university efforts, aiming at students with more sustainable lifestyles. This paper evaluates the sustainability of two hundred and ninety - nine students of an educational institution. The evaluation model is the Input-State-Output, chosen as a model of indicators the ecological footprint, happiness and the average score of students in the course. Specific questionnaires were prepared for data collection. A graphical cube was used to represent students' sustainability, presenting in this study the best scenario among the eight existing ones. Students were classified as "dematerialized" using resources below the capacity offered by the biosphere, have acceptable happiness index and good grades. The cube facilitates the understanding of the result of this evaluation, seeking a better direction of the services provided.

Keywords: *Sustainability. Ecological footprint. Happiness. Academic performance.*

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Sustainable Development and Absorptive Capacity: Connecting Themes Through Systematic and Bibliometric Review

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Abstract

Recent research suggests that the ability to absorb knowledge can drive change in organizational behavior to sustainability. This article aims to present and discuss the panorama of the scientific production on the relation of the absorptive capacity and sustainability. The work was a qualitative research having as strategy the bibliographic study. The databases used were Ebsco, Emerald, Science Direct, and Scopus and the terms used for the searches were "Absorptive Capacity", "Sustainability" and "Sustainable Development". The bibliometric cartographic analysis performed for keywords in the 83 articles by the VOSviewer software searched for terms with at least 5 occurrences. To the qualitative review of the literature, we selected the twenty four articles published in high impact journals. The results point to a significant growth of the theme, and in high impact journals the growth was 61.5% in the comparison of the periods between 2007 and 2012 versus 2013 to 2017. The cartographic analysis points to the presence of two clusters, the first encompasses key terms such as Absorptive Capacity, Sustainability and Innovation, and the second cluster is Sustainable Development, Absorptive Capacity and Corporate Social Responsibility. Qualitative analysis indicates that absorptive capacity facilitates the adoption of successful sustainable strategies and that the engagement of organizations with external actors may prove to be significant. The authors converge in their opinions in the sense that the deep relationship with the external environment is a priority for the acquisition of knowledge and innovative development.

Keywords: *Sustainability, Absorptive Capacity, Innovation*

Factors that Influence the Consumption of Organic Foods

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Abstract

The purpose of this research is to identify the factors that contribute to the consumption of organic foods in the southern region of Brazil. To identify the factors that influence the consumption of organic foods, a questionnaire was applied, resulting in 312 respondents. Where the method used to analyze the responses was the Analytic Hierarchy Process (AHP). The research showed that the main factors that influence consumption are: health, price, knowledge about organic foods. Producers are encouraged to invest in increasing knowledge diffusion; the benefits provided by organic food and work to reduce costs to match prices to conventional products. Future studies may review the question of the influence of relationships, family, and partners, on organic consumption. Also, the deepening of the factors that would influence nonconsumers because it is the largest existing market. Finally, we believe that increasing organic consumption will enable cleaner food production.

Keywords: *organic food; consumption of organic foods; consumer behavior; incentive factors; influencers.*

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The Meanings of Sustainability: A Comparison Between State and Market Discourses

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Abstract

This research aims to investigate convergences and divergences among sustainability discourses on public policies and practices of the so-called "sustainable production and consumption". It was questioned how concepts of sustainability are being taken in public policies and market practices related to "sustainable production and consumption". To do that samples of their discourses were analyzed and compared according to its source, from both public policies and the private sector. The methodologic proceedings comprehend documental analysis for further comparison according to the principles of sociological discourse analysis. The evidences gather from pieces of market and State discourses showed they come from distinct ontological propositions but converge to the mainstream discourse of weak sustainability.

Keywords: *Sustainability. Sustainable production and consumption. Sociological discourse analysis.*

Strategies for the Expansion of Environmental Awareness Effects

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Abstract

Although widely discussed and disseminated in environmental education vehicles, the theoretical reflections about Environmental Awareness and its effects on pro-environmental behavior are scarce, in the sense of analyzing and understanding its purpose, the way it was use and what are the most effective methods for its application. In view of this, the objective of this research was to carry out a narrative review on environmental awareness and propose, through a systematization, strategies to increase the efficiency of its application in the most varied segments of society. Initially, the review prioritized the analysis of understandings about environmental awareness and behavioral science. Subsequently, the motivating and inhibitors factors of pro-environmental behavior were mapped, which were divided into public and private behavior. Next, four strategies were proposed to increase the effectiveness of environmental awareness: (i) redesign of public policies; (ii) binding communication; (iii) product design for sustainable behavior; and (iv) social and environmental marketing.

Keywords: *pro-environmental behavior; environmental awareness; marketing and environmental communication.*

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22nd June 2018

15h00-16h30	Session 6B	Room 3
Behavior of the energy consumption of the air conditioning system for an office building in four climatic zones of Colombia		
Proposal of soil bricks using disposal materials based on the Triple Bottom Line		
Mitigation Evaluation Potential of Environmental Impacts Associated with Leds Recycling		
Evaluation of the Potential of Absorption Refrigeration in Shopping Centers in Barranquilla, Colombia		
Water and Energy Consumption in the Life Cycle of Flush Devices and Gray Water Reuse		

Behavior of the Energy Consumption of the Air Conditioning System for an Office Building in Four Climatic Zones of Colombia

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Abstract

In Colombia, the use of air conditioning systems increases and becomes a fundamental need to ensure comfort in buildings. The analysis of the energy behavior was carried out for four climatic zones of Colombia, including Bogotá, Medellín, Cali and Barranquilla. For each location, a large office building with an air conditioning system was simulated with the EnergyPlus V8.6 simulation tool. The air conditioning system corresponds to a centralized system, where two scenarios were generated, one with variable VAV air volume and the other with constant air volume with Fan Coil FC type terminal units. The results indicate that in Medellín, Cali and Barranquilla the VAV air conditioning system, with 33.5%, 9.7% and 14.9%, respectively, presents greater savings in the total energy consumption of the building, in the case of Bogotá, the use of the FC system with 0.32% has greater potential. The cooling and pumping subsystems also present savings potentials, although to a lesser extent than the global system. The study showed the importance of verification and prediction of energy consumption, considering energy consumption data systems and subsystems installed in the building and basic configurations of air conditioning equipment.

Keywords: energy consumption, air conditioning systems, simulation, buildings, climate.

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Proposal of Soil Bricks Using Disposal Materials Based on the Triple Bottom Line

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Abstract

Urban solid waste (USW) are proving to be an environmental problem, resulting in a challenge for the proper disposal of these wastes, as well as access to a portion of the public more needed the materials to build their homes. Investigate alternatives to these issues through the reuse of USW through the use of scrap tires and scrap of marble workshops, aligned with sustainable principles in the production of ground cement bricks, adding these USW based on the principles of Triple Bottom Line (TBL), has as objective to obtain rational production trying the environmental benefits, economic benefits and social responsibility, without losing the technical quality of these bricks. To assess the quality of the product presented, has as its parameters the tests with additions of tire chips embedded gradually to the composition of the mixture, looking to keep the minimum compressive strength suggested by local standards and norms in force. The purpose of this work aims the benefits listed by TBL, is from the social point of view, with the members involved to produce these bricks can be used in the construction of their houses, is the technological point of view, so that the benefits can be achieved through the reduction of materials used at the time of production and to a lesser amount of disposal and waste, and of social and environmental issues grounded in TBL, by means of insertion of the community in the process seeking the development economical.

Keywords: *Sustainable development, triple bottom line, rubber bricks, urban solid waste.*

Mitigation Evaluation Potential of Environmental Impacts Associated with Leds Recycling

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Abstract

The growing demand for e-waste management studies has not found significant answers in the countries of South America, despite the increase in consumption of electrical and electronic equipment, in particular, for lighting services. This sector is responsible for the consumption of approximately 20% of the global electric energy and it is estimated that more than 15% of it already uses LED. It is evaluated that until 2030 the sector tends to be a great generator of electronic waste. It was studied the recycling routes of LED lighting products available to compare them with each other and with other destination processes, in order to identify potential opportunities to mitigate impacts associated with each one, in order to subsidize managers in their decisions. The LCA protocol was used to map the environmental impacts. We tried to use modeling with local databases, when available. The results point to significant differences in depression in the use of some materials (such as rare earths, germanium, gold and silver) and environmental impacts associated with the disposal of potentially toxic materials (such as arsenic, zinc, copper, nickel, lead, iron and silver). The results vary according to the route of separation and depending on the application niche of the product, since it involves different designs and use of different materials. It was concluded that the choice of route for recycling, compared to other destination processes, can mitigate environmental impacts, but can also generate design requirements for manufacturers of lighting products. These can make your products more environmentally sustainable.

Keywords: LED recycling, impact mitigation potential, recycling route, recycling in lighting.

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Evaluation of the Potential of Absorption Refrigeration in Shopping Centers in Barranquilla, Colombia

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Abstract

This study analyzes the energy potential of an absorption cooling system with solar collectors in different shopping centers in Barranquilla. Field measurements of the refrigeration systems were made and the benefits of this technology compared to the compression refrigeration systems in use were analyzed. The results show that introducing refrigeration by absorption, can generate electricity savings of up to 74.25%, with a decrease of up to 47.12 Tonnes / year of CO₂ equivalent for the percentage without the use of electricity.

Keywords: *Refrigeración, absorción, electricidad, colector solar y centro comercial.*

Water and Energy Consumption in the Life Cycle of Flush Devices and Gray Water Reuse

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Abstract

This article aims to analyze, through the Life Cycle Assessment, three scenarios with different solutions for the availability of water on toilets of a classroom building of a University in Southern Brazil. In the first scenario, single-flush devices were used on all toilets of a campus building. In the second scenario, dual-flush devices were used and in the third scenario, the installation of dual-flush devices and a gray water reuse system from the washbasins in the toilets were analyzed. The objective was to quantify the environmental impacts in the three scenarios by comparing the use of single flush and water-saving devices and also the reuse of the gray water in terms of water consumption and energy consumption. Measurements of the available plumbing fixtures were done in two stages, with single-flush and dual-flush devices. The environmental impact assessment was carried out with the support of the SimaPro 8.3.0 software. The replacement of flush devices reduced water consumption in the operation stage of the toilets on 37.38%. The highest water and energy consumption occurred in scenario 1, due to the higher demand for water in the operation stage and higher energy expenditure for the pumping and treatment of the water. The gray water reuse in scenario 3 decreases the amount of water consumed in the toilets, but it consumed a greater amount of energy when compared to scenario 2, which counted only with dual-flush on toilets. The results showed that it is environmentally feasible to replace the single-flush with dual-flush devices in the campus toilets.

Keywords: *Life Cycle Assessment. Flush devices. Water-saving systems.*

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22nd June 2018

15h00-16h30	Session 6B	Room 4
Analysis of Water Consumption in Toilets with Shewhart Control Charts		
Evolution of Environmental Performance Indicators in Colombia: Case Study in Industrial Sector Cali - Yumbo		
Chemical Footprint of Brazil: A case of study of Dioxins and Furans		
Cleaner Production: Application Analysis in Mass Services and Professional Services		

Analysis of Water Consumption in Toilets with Shewhart Control Charts

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Abstract

The article aims to show if it is possible for Shewhart Control Charts to have competent data monitoring capabilities when observing a switch in toilet flush equipment from single flush to dual flush in a public University building located in Joinville, southern Brazil. Sensors collected data such as volume of water and time length of the flush. Such data was then trimmed and compiled into days and finally plotted into a Shewhart Control Chart. The switch in flush equipment indicated a reasonable reduction in water consumption for both male and female bathrooms presenting an average total reduction of 33.15% in water consumed during a day and a reduction in the average time length of flush of 23.95%. With periodic monitoring Shewhart Control Charts proved to be useful for observing large shifts of data, water consumption reduction and events such as leakages and droughts that occurred during the data gathering period.

Keywords: *Water consumption, monitoring, Shewhart Control Charts.*

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Evolution of Environmental Performance Indicators in Colombia: Case Study in Industrial Sector Cali - Yumbo

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Abstract

This paper shows the results of the monitoring of the application of Environmental Performance Indicators in the industrial sector between the cities of Cali and Yumbo - Colombia from 2005 to 2013. The lack of an evaluation of the indicators makes it difficult for organizations, community and state establish policies, priorities and organizational, sectoral and municipal strategies in matters of environmental management, public and commercial health. The methodology used was environmental management procedure techniques such as ISO 14031 for the selection and evaluation of 34 Indicators of Productive Action (IAP), Environmental Conditions (ICA) and Directive Performance (IAD), through a survey. The results of the evaluation of the indicators allowed identifying opportunities for productive, environmental and managerial improvement of the organizations. Likewise, to specify the potential that the manufacturing industry of these cities must participate in eco efficiency chains, markets and green businesses in the world.

Keywords: *Environmental Performance Indicators; ISO 14031; Cleaner Production; Environmental management.*

Chemical Footprint of Brazil: A Case of Study of Dioxins and Furans

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Abstract

Dioxins and Furans are part of the Persistent Organic Pollutants (POPs) with high potential to cause harmful impacts to humans and the environment. Considering that life quality is negatively affected by the presence of these substances into the environment, this paper calculates the potential damages to human health based on the USEtox risk model and the Brazilian inventory of Dioxins and Furans. The potential damage to health is indicated by the chemical footprint of the Brazilian states, which is associated with geographic and demographic characteristics of each region. The total calculated impact score for Brazil is 621 DALY, the state of São Paulo (SP) is the first in the ranking with 27% of the calculated impact, followed by Minas Gerais with 16%, Rio de Janeiro with 12%, Espírito Santo with 10%, Pará with 7%, Paraná with 4%, Rio Grande do Sul and Mato Grosso with 3% each. These eight states concentrate 80% of the impacts caused by Dioxin and Furan emissions. The impact score indicates the potential impacts on human health and is an alternative reference for ordering the emission source categories and can aid in decision making for public policies. The impact scores based on the population $IS_{pcapita}^{UF}$, the Gross Domestic IS_g^{UF} , and the area $IS_{km^2}^{UF}$ show a significant variation when comparing the ranking of each indicator, and it is possible to use them jointly or individually to compare the chemical footprint of the states.

Keywords: LCIA, Chemical Footprint, Dioxins and Furans, USEtox.

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Cleaner Production: Application Analysis in Mass Services and Professional Services

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Abstract

Currently, the society and the market have a holistic view of environmental questions and they are concerned not only with economic benefits but also with the consequences they bring to the environment. The growth of the service sector means that the service rendering knows and measures its environmental impacts and minimizes its negative influence. The Cleaner Production Program uses tools that associate economic, social and environmental benefits to an organization's activities. In this sense, this study proposes to analyze the Cleaner Production two companies providing professional and mass services, according to the Schmenner classification. Two stages were used, from the five of the Cleaner Production methodology, pre-evaluation and evaluation, followed by an approach that integrates concepts and principles of Quality Management in the Process proposed by Paladini, Cleaner Production and the methodology PDCA. As a result, it was observed that the organizational culture determines the vision of the purpose for the implantation of the Cleaner Production. However, it is possible to affirm that, with the adoption of Cleaner Production, service providers will know the environmental aspects and impacts of the process and the service, and identify opportunities for cost reduction, resulting in the growth of the organization.

Keywords: *Cleaner production; services; sustainability.*

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22nd June 2018

15h00-16h30	Session 6B	Room 5
The Artisan Paper Recycling as a Strategy of Community Environment Education from UNIOESTE – Foz do Iguaçu Campus		
The action research as instrument of enhancement of the materiality process		
Thermal Comfort Assessment in an Educational Institution in Barranquilla		
The Use of PLS-SEM in Sustainability-Related Research		

The Artisan Paper Recycling as a Strategy of Community Environment Education from UNIOESTE – Foz do Iguaçu Campus

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Abstract

With the laws and state regulations, the University of the West of Paraná – UNIOESTE cannot stop producing printed documents, which brings a big volume of paper that is discarded. To be in compliance with the Law nº12.305/2010 the project “Your Role in Society” was created, within it the paper discarded on the administrative sectors is collected, separated and artisan recycled. That recycled paper then returns to the administrative sectors in the form of institutional interest products. The project has evolved going beyond the University walls, being transformed into an extension project. That is the reason that the main objective has turned into the offering of recycling and good sustainability practices workshops, meeting the needs of public and private organizations and the community in general, initially the focus will be mainly with the institutions there are geographically close to UNIOESTE – Foz do Iguaçu Campus. At those workshops it is possible to replicate the artisan recycling technique, provide learning and fun in case it is being applied to kids, and train multipliers in case it is being applied to professionals. Furthermore, the team counts with an assistant professor, specialized in Chemical Engineering, that analyses the effluents resulting the artisan production, suggesting methods and processes to minimize even more the aggressions to the environment.

Keywords: *environment management, social and environment responsibility, paper artisan recycling.*

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The Action Research as Instrument of Enhancement of the Materiality Process

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Abstract

This research has a goal of understanding the implementation of the theory of materiality in the perspective of enterprise sustainability. Since the approach of conduction of the application is not clear, it was necessary to perform an action research to check the main barriers on the application of the theory organized by the Global Report Initiative. In this regard, the research has used the concepts of Flipped Classroom with students of two classes of the sixth semester of Industrial Engineering. The understanding and interpretation of these data was made by content analysis through the software ATLAS.ti. As result and main academic contribution, this research preceded a real application on the enterprise environment. Thus, in addition to eliminate potential problems of development of the approach, this article has the role of being the link between theory and practice during the application of the materiality in corporative environments. The limitation of the article is exposed during the sampling, where these students do not have much professional experience. But this little practical experience of the students can also be witnessed in the companies through his employees, who many times do not know the theory. The aspect of originality is presented, till then, the first research that simulates a real application of materiality.

Keywords: *Materiality, Action Research, Flipped Classroom, Content Analysis, Teaching in Higher Education.*

Thermal Comfort Assessment in an Educational Institution in Barranquilla

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Abstract

Motivation, performance and learning velocity of students is influenced by thermal comfort, for this reason educational institutions have been investing in air conditioning equipments whit the consequent increase in power consumption. This trend is being accentuate in cities with tropical climates. Currently, standards such as ISO 7730, EN 15251, and ASHRAE 55 are being used to evaluate thermal comfort in existing buildings, to design air conditioning systems and establish parameters (operating temperature and comfort equations) in new buildings. Many comfort studies have been carried out in different climates and seasons around the world and differences have been found in the operating temperature interval that provides comfort, due to this is being recommended to conduct comfort studies in different climatic zones and educational entities to have different databases that allow having reliable comfort temperatures and revise the standards. The following work is intended to evaluate thermal comfort, using the ASHRAE 55 standard, in educational classrooms in the city of Barranquilla, specifically in the postgraduate building

Keywords: *thermal comfort, tropical climates, ASHRAE 55.*

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The Use of PLS-SEM in Sustainability-Related Research

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Abstract

PLS-SEM is a method for statistical treatment of data that requires relatively small samples to generate satisfactory results. In addition, the model estimations provided by this technique are very robust. In this context, the present research aims to review the literature regarding the articles published by the Journal of Cleaner Production that use this technique to analyze their results. Forty-five items were found. Of these articles, forty fit the requirements stipulated for this research. In view of the results obtained, it is possible to verify that developing countries present research with this technique. In addition, the number of publications using PLS-SEM has been increasing over the years. It is concluded that this is a promising technique, which has gained more adherence in recent years and is used with reasonable frequency in research focusing on sustainability.

Keywords: *Structural Equation Modeling; PLS-SEM; Literature review.*

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“CLEANER PRODUCTION FOR ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS”

Barranquilla – Colombia – June 21st - 22nd - 2018

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.

22nd June 2018

15h00-16h30	Session 6B	Room 6 (English)
Economic Viability and Flammability of Polyurethane Composites, Aluminum Sludge and Polyethylene Terephthalate Residue		
The sustainability of the Italian water sector: an empirical analysis by DEA		
Denim Weaving Technologies: Environmental and Economic Evaluation		
Circular Economy and Bioeconomy: How Are They Related?		
Greenhouse Gas Inventory of the State of Sonora, México		

Economic Viability and Flammability of Polyurethane Composites, Aluminum Sludge and Polyethylene Terephthalate Residue

MARQUES, D. V.^a, AGUIAR, A. C.^a, BARCELOS, R. L.^{a,b}, SILVA, H. R. T.^a, EGERT, P.^a, MAGNAGO, R. F.^{a*}

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Abstract

Polyurethane is used in the construction industry because of its excellent thermal performance in roofs, floors, and concrete slabs. However, its high flammability restricts the use. The study reports the use of polyethylene terephthalate and aluminum-anodizing sludge residues in the production of boards with different densities and fire resistance. Boards with 10%, 20%, 30%, 40%, and 50% of polyethylene terephthalate residue were prepared to replace primary polyurethane raw materials, to which 20% aluminum sludge was added. In the horizontal burning test (UL94), the boards presented a combustion deceleration until flame extinction due to the presence of aluminum-anodizing sludge. There was a cost reduction of about 70% for the boards with the greatest amount of residues incorporated. The construction industry should consider incorporating waste into the life cycle of products from other segments as part of its formulations, saving natural resources and becoming more sustainable.

Keywords: *Aluminum sludge; Polyethylene terephthalate (PET); Polyurethane (PU); Recycling; Flammability.*

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The Sustainability of the Italian Water Sector: An Empirical Analysis by DEA

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Abstract

The sustainability of the development of water resources is a pressing challenge. Natural forces, economic pressure and increasing population determine a significant growth in water use and pollution not supported by highly inefficient water supply practices. In this framework, the Italian water services with fragmented management, highly deficient collection and treatment of wastewater - and existing and potential problems in water supply in some areas of the country - explains the reasoning of the drastic restructuring introduced by Law 36/1994 for hydro services. The impossibility of avoiding natural monopoly and the necessity to industrialize the whole sector determined the imposition of a "for the market" competition in order to exploit possible economies of scale and scope. In this work, a group of Italian water utility companies is used to assess the sustainable efficiency of the Italian water sector, using the mathematical/linear programming of Data Envelopment Analysis (DEA). This well-known technique allows evaluating the systems efficiency not only by calculating the efficiency of each unit, but also helping policy makers by suggesting corrective policies and measures which could make the inefficient units efficient. This approach can be useful for policy makers to direct decisions towards a more sustainable and efficient water sector.

Keywords: *Water industry, Efficiency, Sustainability.*

Denim Weaving Technologies: Environmental and Economic Evaluation

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Abstract

The textile sector is relevant in the Brazilian economy due to both job creation and industrial production value. Currently this sector faces the necessity to implement Cleaner Production tools for achieving the sustainable development goals as a consequence of pressures exerted by government and market. Therefore, the aim of this study is to evaluate the economic and environmental gains resulting from the utilization of the Design for the Environment considering two main technologies used to manufacture denim fabrics. To achieve this objective, a case study was developed in one of the major Brazilian denim producers where the two waving technologies are used in parallel. As a result of the case study, it was possible to conclude that air jet looms are more efficient than the older rapier looms, not only in terms of economic gains but also in terms of lower impact to the environment.

Keywords: *Cleaner production; Design for the Environment; textile industry.*

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Circular Economy and Bioeconomy: How Are They Related?

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Abstract

Given the consensus on the urgency of environmental issues and growing concern about the scarcity of natural resources, new models related to sustainable development have been proposed. Thus, the general objective of this article is to analyze how two of these concepts that permeate sustainability — Circular Economy and Bioeconomy — have been combined in the scientific literature. It also aims to identify how biorefineries are part of this context. In order to reach the proposed objective, it was decided to use the systematic literature review procedure following the protocol proposed by Cronin, Ryan, and Coughlan (2008), from *Scopus* database. Besides synthesizing knowledge about this subject, the article highlights the characteristics of the studies (temporal distribution of publications, main journals, major themes addressed, authors and their respective countries), as well as methodological aspects, main initiatives and programs, and the actors involved. The results showed that although the first studies date from 2016, the increasing interest of researchers in the subject is evident. The recent initiatives of Circular Economy and Bioeconomy formulated by the European Union in 2012 and 2015 and the United States National Bioeconomy Blueprint are policies guiding the actions of the countries that have published most about these subjects. As for the methods of analysis, there is a domain of the LCA method (Life Cycle Assessment) in the studies that deal with the environmental impacts of the productive processes. From the analysis of the network created by the most recurrent keywords, it was possible to perceive a greater centrality and strength around the term Circular Economy, and the second keyword with the greatest prominence is Bioeconomy, which reinforces the relation of complementarity of the approaches. Finally, studies point to the need for cooperation between the scientific community, private companies, government, and society to establish an effective environmental policy based on the principles of Bioeconomy and Circular Economy.

Keywords: *Circular Economy, Bioeconomy, Biorefinery, Sustainability, Systematic Literature Review*

Greenhouse Gas Inventory of the State of Sonora, México

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Abstract

In the last decades, as part of the urgency of solving environmental problems, several agreements have been generated regarding the reduction of Greenhouse Gases (GHG) (Diamantoudi and Sartzetakis, 2006). The United Nations Framework Convention on Climate Change (UNFCCC) together with the Intergovernmental Panel on Climate Change (IPCC for its acronym in English) seek the stabilization of GHG emissions with respect to the pre-industrial era (Duarte, 2006). The Paris Agreement in 2015 established GHG reduction targets for developed countries and committed them to financially support developing countries (Martínez, 2017). However, the commitments of the nations involved in taking strategic measures to reduce the generation of GHG are still insufficient to minimize climate change (La Jornada, 2017). The main objective of this work is to show the results and experiences obtained during the creation of an inventory of greenhouse gases for the State of Sonora, Mexico and expose the limitations in the generation of this type of inventories.

Keywords: *Greenhouse Gases Inventories, Climate Change*

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22nd June 2018

15h00-16h30	Session 6B	Room 7 (English)
Removal of Lead (Pb) by the Rhizofiltration Technique Using <i>Thitonia diversifolia</i> (Hemsl) A. Gray (False Sunflower) Plants		
Comparative study between conventional and clean extraction techniques and characterization of the biocomposites of Brazilian ginseng <i>Pfaffia glomerata</i> using FT-RAMAN and FT-NIR		
3D Surfaces Design for microalgae cultivation in Algal Turf Scrubber systems		
An Eco-Friendly Harvesting of Microalgae Using Combination of Microbial Flocculant and Chitosan in Simulated Eutrophic Water		
Recovery of Heavy Metals from Waste Printed Circuit Boards through Microbiological Leaching, Using Consortia of Acidophilic Chemolithotrophic Bacteria		

Removal of Lead (Pb) by the Rhizofiltration Technique Using Thitonia diversifolia (Hemsl) A. Gray (False Sunflower) Plants

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Abstract

Waters contamination by heavy metals represents a environmental problem due to its high toxicity for both humans and the environment. Heavy metals tend to accumulate because of their resistance to degradation. The vegetable species *Thitonia diversifolia* (Hemsl.) A. Gray, was used for the removal the lead (Pb) in a synthetic solution using the rhizofiltration technique in two different germination ages 2 and 4 months with three different concentrations of the heavy metal 20, 15 and 10 mg / L.

The *Thitonia diversifolia* species proved to be efficient in the removal of lead with greater than 90% for the two germination ages evaluated. The highest amount of lead was concentrated in the roots. This because the False sunflower belongs to the dicotyledonous class and according to bibliographic review these accumulate significantly high amounts of lead in the roots.

Keywords: *rhizofiltration, lead, thitonia diversifolia, removal.*

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Comparative Study Between Conventional and Clean Extraction Techniques and Characterization of the Biocomposites of Brazilian Ginseng *Pfaffia glomerata* using FT-RAMAN and FT-NIR

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-

Abstract

The Brazilian ginseng *Pfaffia glomerata* (Spreng.) Pedersen is a native plant of Latin America. Its therapeutic properties had been discovered by the Japanese pharmaceutical industry, since many researches have been carried out to obtain biocomposites. The main compound of interest is β -ecdysone, a natural steroid present in the plant roots. The therapeutic properties attributed to ginseng are anti-inflammatory, antimicrobial, antioxidant, antitumor, memory enhancer and tonic. In addition to β -ecdysone, terpenes, triterpenes, nortriterpenes and phenols are also found. It's use has also been explored by the food industry as a surfactant technological agent and emulsion stabilizer. The objective of the present study was to compare conventional and clean biocomposite extraction techniques, as well to characterize the Brazilian ginseng *Pfaffia glomerata* using FT-RAMAN and FT-NIR spectrophotometers. The results showed that roots are an excellent source of carbohydrates when extracted by the clean technology via subcritical water (SWE), with a yield of 13.22% higher than the classical organic solvent methodology via Soxhlet. The use of clean supercritical fluid extraction technologies, specifically SWE, corroborate with the Sustainable Development Objectives (ODS), as they are environmentally sound technological innovations. Near-infrared spectrophotometric (NIR) and nuclear magnetic resonance (FT-RAMAN) analyzes demonstrated several chemical groups with technological potential, with emphasis on mineral selenium (Se). This mineral imparts antioxidant and anti-inflammatory activity to the human organism, which have been observed in several peaks of the spectra. When compared the β -ecdysone standard with the extract of the ginseng root in the FT-RAMAN spectrum, we observed eight identical peaks, confirming the presence of the compound in the roots of *P. glomerata*.

Keywords: ODS, supercritical fluids, clean technology, spectrophotometry.

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3D Surfaces Design for Microalgae Cultivation in Algal Turf Scrubber Systems

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Abstract

Several researches have shown that the surface relief of the microalgae cultivation area in Algal Turf Scrubber - ATS systems directly influences productivity. Large-scale ATS systems are being employed to sequester Nitrogen and Phosphorus from lakes and eutrophic environments. The adoption of this technology presents a new vision in systems of treatment and recovery of water sources, mainly for those that serve as water supply for their populations. This article discusses the preliminary phase of the research that aims to develop 3D surfaces for microalgae cultivation in ATS systems in laboratory scale, incorporating technology and evaluating the environmental performance of the system to guide research with large scale application. The definition of surfaces used was based on rocks, natural fibers and mathematical models that extend the effective surface of the 3D model in relation to a projected surface. Consideration was given to the ease of obtaining the raw materials for molds and models and the complexity of the surfaces to be created to facilitate the cleaning of the surface and the harvesting of the algae in determined periods. The product design also aims to facilitate the large-scale manufacturing process, so it was employed various techniques for the preparation of surfaces such as: 3D modeling, 3D printing, 3D scanner, resin molding and gluing. Current results have shown that it is possible to develop low-cost, easy-to-manufacture 3D surfaces of medium complexity, thus providing the widening of the available surface area that can directly impact microalgae productivity.

Keywords: *Algal Turf Scrubber, Microalgae, Eutrophication, Product Design, 3D Surface*

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An Eco-Friendly Harvesting of Microalgae Using Combination of Microbial Flocculant and Chitosan in Simulated Eutrophic Water

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Abstract

Cyanobacteria usually occurred in eutrophic waters, but the harvesting of microalgal biomass by flocculation was still facing a major technological and economic challenge. In order to solve this problem, the combination of microbial flocculant (MBF) and chitosan was used to flocculate the biomass of *Microcystis aeruginosa*. The addition sequence of MBF and chitosan had an important influence on flocculation, and the best flocculation method was as follow: MBF (5 mL/L) was added firstly into algal culture, then the chitosan (30 mg/L) was added, MBF (5 mL/L) was added again at last. In this way, all the algal cells aggregated together, and the algal flocs floated on the surface of solution and the algal flocs could be harvested by net (0.15 mm) easily, which exhibited the highest separation efficiency of 98.33 %, the lowest total phosphorus of 0.74 mg/L and neutral pH (6.61) of supernatant. Zeta potential measurement confirmed the flocculation mechanism was charge neutralization. Microscopic observation revealed that some bubbles attached to the algal flocs which increased buoyancy of flocs. Some advantages above proved that combination of chitosan and MBF was a promising technology to harvest cyanobacteria.

Keywords: *Microcystis aeruginosa*; microbial flocculant; chitosan; flocculation; zeta potential

Recovery of Heavy Metals from Waste Printed Circuit Boards through Microbiological Leaching, Using Consortia of Acidophilic Chemolithotrophic Bacteria

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Abstract

An alternative to reduce environmental impact and cost in the extraction of metals from electronic waste is the use of bacterial leaching processes. In this work, the recovery of heavy metals from wasted printed circuits boards (WPCBs) of desktop computers through bacterial leaching processes has been investigated. Consortia of chemolithotrophic acidophilic bacteria were obtained from acid water and rocks from a local mining action, and from microorganisms isolated from WPCBs. We used X-ray fluorescence spectroscopy to quantify the amount of metals present in WPCBs before, during and after exposure with the isolated bacterial study consortia. Growth conditions of the microorganisms were studied, metal leaching rate present in the WPCBs by these consortia was determined under different conditions of pH, temperature and agitation in several bioassays. This study demonstrated the bioleaching of toxic metals such as lead, nickel and chromium, as well as other metals such as iron, calcium, zinc, manganese, copper, osmium, tantalum, platinum, and gold.

Keywords: *Bioleaching, heavy metals, chemolithotrophic bacteria, printed circuit boards (PCB), adaptation*

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22nd June 2018

15h00-16h30	Session 6B	Room 8
Renewables energies in Colombia and the opportunity for the offshore wind technology		
Conceptual Proposal of Energy Efficiency Analysis: Case Study in Solar Systems		
Eco-efficiency assessment of a photovoltaic solar energy installation in Accommodation and Lodging Establishments (ALE). A case in the Guajira, Colombia		
Thermal Behaviour of Electrical Distribution Transformers Immersed in Natural Ester Fluids		
Dynamic Modeling and Simulation of an Hybrid Renewable Energy System in Colombia		

Renewables Energies in Colombia and the Opportunity for the Offshore Wind Technology

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Abstract

This paper displays a review of the literature which shows international actions that have motivated different countries to establish strategies to reduce CO₂ emissions and the high dependence on fossil fuels. Additionally, advances and challenges of the offshore wind energy are presented through the experiences of several countries. The administrative framework of the renewable energy, the potential of marine energy, and the needs and opportunities of Colombia are shown. The present document gathers technical, economic, administrative and legal information of the renewable energies in Colombia that may be used for taking decisions of different stakeholders.

Keywords: *wind energy, offshore, renewable energy, Colombia, marine energy.*

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Conceptual Proposal of Energy Efficiency Analysis: Case Study in Solar Systems

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Abstract

The rapid population growth in urban areas, expected in the near future, will make the energy crisis getting increasingly worse. The most common ways for obtaining energy, are provided by nonrenewable sources that are running out soon. One of the solutions is use the renewable sources, like photovoltaic. Some disadvantages of this kind of energy are the high cost, low efficiency and the uncertainty of the electric generation. To reduce the geographical factors interferences, was developed a method able to calculate the photovoltaic system according to the weather conditions where the system is installed and the installation available area. After recalculate the quantity of photovoltaic modules, was possible to perceive that although the initial investment rising, the system had a lower payback time and the profitability has increased significantly than the conventional system.

Keywords: *Energy Efficiency, Photovoltaic Modules, Re-design of Photovoltaic Plant.*

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Eco-efficiency Assessment of a Photovoltaic Solar Energy Installation in Accommodation and Lodging Establishments (ALE). A Case in the Guajira, Colombia

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Abstract

Eco-efficient technologies for the production of electricity are those that when compared with other technological options generate lower environmental impacts and their cost within the energy system is less expensive. In Colombia and specifically in La Guajira, the potential of renewable energy (ER) is presented as an eco-efficient technological alternative to improve the environmental impacts caused in the production and consumption of electricity in the housing sector. In this sense, this document shows part of the results of a research developed as a doctoral thesis, carried out in the Accommodation and Lodging Establishments (EAH) of the department of La Guajira. The objective of this research is the development of a methodological model of eco-efficient technological solutions as a management tool that contributes to the environmental sustainability of the EAH taking into account that this region has great potential for the development of photovoltaic solar technology. In the current work, part of the results obtained in this doctoral thesis is presented. These results were obtained under a mixed experimental approach to a population of 375 ALE that had at least 5 years of operation and active registration at the Chamber of Commerce of La Guajira in 2016. A questionnaire of 58 items was designed and applied to a sample of 169 LAE. Likewise, for the construction of the Methodological Model of Eco-efficient Technological Solutions two methodologies were used: Methodology 1, consists in the technical evaluation through which the components of the solar photovoltaic system are dimensioned, either for autonomous systems or connected to the network, although in this research it was only designed for autonomous systems; Methodology 2, evaluates the eco-efficiency of photovoltaic solar technology by applying the Colombian Technical Norm NTC-ISO 14045 (2013). In this evaluation 2 methods were used, Method 1 involving environmental evaluation through the Cycle Analysis of Life (LCA), through the application of ISO 14040 and ISO 14044 with the help of SIMAPRO software and the 2011 ILCD environmental impact method. Method 2 to assess the value of the product system. In this case, the solar photovoltaic system for the generation of electricity through the software HOMER PRO was created. Results show that although photovoltaic technology is more eco-efficient than the technology that currently works in the EAH (reduces the emission of CO₂ by 74 %). From economical point none of the two technologies; it is eco-efficient because they do not have a rate of return on investment. This fact highlights the need to continue in this line of research.

Keywords: *Solar Photovoltaic Energy; Eco-efficiency Technologies; Sustainability management; Accommodation and Lodging Establishments*

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Thermal Behaviour of Electrical Distribution Transformers Immersed in Natural Ester Fluids

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Abstract

Since the early 1990s, natural ester fluids have been developed as an alternative to the growing energy and environmental crisis that face the planet. Its main advantages in comparison with mineral oil are: they are biodegradable, they come from a renewable resource, and their safe operation due to their high flash point. However, their cost of acquisition, the few studies reported, that can support their long-term operational characteristics and short application times, are barriers that limit their massive implementation.

This study presents a finite element method (FEM) analysis of the thermal behavior of an electrical distribution transformer using a natural ester fluid as dielectric liquid in a distribution transformer. Additionally, the study will be carried out in the same equipment using mineral oil and natural ester in order to compare results.

Keywords: *natural ester fluids, finite element method (FEM), thermal behavior, distribution transformers.*

Dynamic Modeling and Simulation of an Hybrid Renewable Energy System in Colombia

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Abstract

The hybrid system switched to the production of electric energy allows supplying the energy demand in Non-Interconnected Zones, contributing both to the improvement in the reduction of greenhouse gas emissions and to the rational use of energy. A comparative analysis of the performance of these systems was supported out in this study for four sites in the Colombian Caribbean region, using a dynamic model programmed in Matlab, which integrated the equations of a Southwest Wind Power Inc. wind turbine. AIR 403, a proton exchange fuel cell (PEM), an electrolyzer, a solar panel and a charge regulator based on PID controllers to manipulate oxygen and hydrogen flows in the cell. The transient responses of the cell voltage, current, and power have obtained for the demand of 200 W for changes in solar radiation and wind speed for all days of the year 2013 in the Ernesto Cortissoz airport, Puerto Bolívar, Alfonso López airport and Simón Bolívar airport, by regulating the flow of hydrogen and oxygen into the fuel cell. The maximum contribution of power generation from the fuel cell was presented for the Simón Bolívar airport in November with a value of 158,358W (9.45%). While the minimum has shown in Puerto Bolívar with 18,141W (3.745%), which allowed to evaluate the changes in the complementarity of these energies for this system. Finally, the simulations of the hybrid energy system allowed us to select Puerto Bolivar's location as the most efficient for the hybrid system's operation because the high potential of wind and solar energy makes it possible to have low consumption of hydrogen and oxygen flow.

Keywords: Fuel cell, PID control, Hybrid energy system, Caribbean region, simulation.

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22nd June 2018

16h50-18h50**Special Conference - ACPN Medal
Award - Senior Researcher**

Carlo Vandecasteele

University of Leuven - Belgium

**Cleaner Production (in industry
and services) to Mitigate Climate
Change**

Cleaner Production (in industry and services) to Mitigate Climatee

Carlo Vandecasteele

KU Leuven, Department of Chemical Engineering, Heverlee, Belgium

One of the 17 sustainable development goals (goal 13) adopted by the United Nations on September 25, 2015, is 'climate action', i.e. 'to take urgent action to combat climate change and its impacts'. The major economic sectors contributing to climate change are worldwide: (1) Electricity and heat production (25%), (2) Agriculture and forestry (24%), (3) Industry, and (4) transportation (IPCC, 2014). Cleaner production (or resource efficient and cleaner production), which includes measures to reduce greenhouse gas (mainly CO₂, CH₄, N₂O and fluorinated gases) emissions offers thus in all these sectors the opportunity to combat and mitigate climate change. In this context, emissions over the entire life-cycle of a product or process must be considered.

After a short introduction on targets for the reduction of greenhouse gas emissions, the paper will first give an overview of where, in the practical implementation of cleaner production, measures to reduce greenhouse gas emission can be taken. Burning of fossil fuel for electricity and heat is the largest single source of global greenhouse gas emissions. Greenhouse gas emissions from industry may involve fossil fuels burned on site at facilities for energy generation, but also emissions from chemical, metallurgical, and mineral transformation processes not associated with energy consumption, as well as emissions from waste management activities. Moreover energy saving measures result in less electricity or heat consumption, thus reducing greenhouse gas emissions related to electricity and heat production. Recycling of input materials often requires a lower energy input than producing these from new resources, so that selection of appropriate input materials, along with on-site reuse and recycling may reduce the emission of CO₂. This aspect of recycling will be discussed in some detail. The possibilities for the reduction of greenhouse gas emissions may thus be summarized as follows:

1. Input material substitution: use less impacting or, preferably, renewable energy or fuels; use input materials obtained with lower greenhouse emissions, e.g. by recycling.
2. Technology change and process modification: energy use may be decreased and product efficiency increased by the use of optimal; process conditions, by improved process control or by designing a completely new process.

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3. Improved operational practices: energy management; maintenance programs; proper maintenance.
4. Product modification, so that less CO₂ is emitted during the production.
5. On site reuse and recycling.

All these aspects will be illustrated mainly by case studies by the authors in Belgium, Colombia and Cuba, including production of cement and lime with lower emission of CO₂, forecasting and control of energy consumption in hotels, cleaner production in a fish treatment factory, battery production, pig production etc. These are relatively small projects, in which several of the aspects given above were addressed. The impact of these projects on climate change will be estimated.

In industry, major gains for climate change can also be made by highly integrating industrial production in networks along the lines of industrial ecology. On the one hand in a large industrial complex a material network can be realized, with vertical integration (a large fraction of the base and intermediate products are produced on site, leading to a large range of products). The different vertical production chains may also be interconnected (horizontal integration: by-products or waste from a given vertical production chain are used as base material in other production chains). The material network leads, next to material savings also to energy savings, as e.g. less transport is needed because all the installations are concentrated on the same site, and to reduced emissions of CO₂. In addition, an energy network is possible. In most large industrial complexes both endothermal and exothermal processes take place; some production processes thus require energy, others give energy. The energy can flow from one installation to another under the form of steam. Connecting the energy flows using a heat exchanger network could considerably lower the total energy consumption, as process heat that would otherwise be lost is reused. This will be illustrated by examples from the chemical industry in Flanders, Belgium.

In addition, the production of electricity and heat of course offers also large opportunities to reduce CO₂ emissions, by producing renewable energy (solar thermal energy, solar photovoltaics, bioenergy from (waste) biomass, hydroelectricity, wind energy, ...). This will be illustrated by two cases 'Biomass based electricity generation potential of the Province of Cienfuegos, Cuba' and an example from the waste management sector: the 'Ecluse Network of Sleco, Antwerp', which supplies steam produced by combustion of industrial waste, household waste and sewage sludge, directly to several chemical industries requiring energy. This affords a much higher energy

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efficiency as when the produced steam is used to generate electricity. Moreover the impact of solar and wind energy will be considered.

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22nd June 2018

18h50-19h50

**Special Mention Award, Closing
Ceremony and Cocktail**

In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 7th International Workshop, UNIP, Barranquilla, Colombia. June 21st - 22nd, 2018.*

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