OUTLINES
Thursday 25th June

VANDENBOSSCHE Virginie (LCA) ~60min
Biomass pretreatment by extrusion and reactiv-extrusion

DE LEON Rizalinda (FETSL) ~60min
Bioethanol production from alkaline-pretreated sugarcane bagasse by consolidated bioprocessing using Phlebia sp.

Lunch time (pack lunch in Bio5)

Presentation of EAD8 (FAME) and
visit of experimental capacity ~60min

DE LEON Rizalinda ~30min
FETSL presentation to FAME Team

CAMELEYRE Xavier (LISBP) ~60min
Microbial valorization of hydrolysed or pretreated lignocellulosic biomass

LISBP LABORATOIRE D'INGÉNIERIE DES SYSTÈMES BIOLOGIQUES ET DES PROCÉDÉS
INRA SCIENCE & IMPACT cnrs INSA TOULOUSE Université de Toulouse

Department of Chemical Engineering
University of the Philippines-Diliman

Fuels, Energy & Thermal Systems Research Laboratory

Rizalinda de Leon
Angela Escoto
Hyacinth Tambago
Kristian July Yap

Members 2015

The lab that loves to eat together, gets to work happily together to get results!

Noga, Elise, Estelle

Grenny, Almira, Michael

Hyae, Mesh, Alfrie

Raf, Marion, Eira

Don, Aaron, Matthew

Freddie More

J4, Carla, Rhia, Abern, Marco, Sheila, Alvin, Theresa, Khaye

Vision

Technologies and products toward sustainable energy utilization

Mission

Train students to scan the technology horizon and look for:

- important questions yet unanswered;
- needs yet unmet, and;
- opportunities still emerging,

and to use the scientific method to seek out the answer, the solution or the enabling technology.

Our Focus

More efficient, integrated and effective processes for converting biomass and other residue into fuels and high-value products.

Better understanding of energy conversion and thermal systems to inform their continuous development and promotion.

Fuels

- Source
  - Cellulosic
  - Microalgae
  - Oil seeds
  - Biogas/Natural Gas
- Process
  - Chemical
  - Thermal
  - Biological
  - Separation
- Characterization
  - Properties
  - Analysis
  - Performance
  - Yield

Department of Chemical Engineering
University of the Philippines-Diliman

Fuels: Sources

Cellulosic

Arni Gambe (MS)
sherrie Medes (MS)
Myra Borines(PhD)
Paul Halal (MS)
Stephen Doliente (MS)
Jeric Macalintal(MS)
Le Duy Khuong (PhD)
Marco Lao (MS)

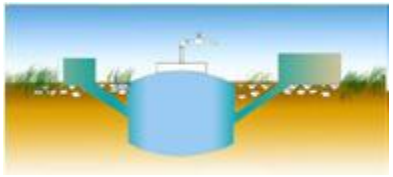
Microalgae

Ryan Reynoso (MS)
Rowena Carpio (MS)
Rhia Carla Duca (MS)

Oil seed

Kathrina Montalbo(MS)

Biogas/Natgas (enhancement)



Aldrin Calderon (PhD)

Waste-to-Energy

Randy Consignado (MS)

Water & Light

Hyacinth Tambago(MS)
Kristian July Yap(MS)
Joseph Yap IV(MS)
BPI Science Best Proj(BS)
UPC First Placer (BS)

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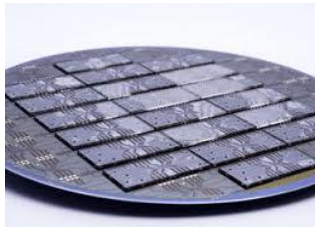
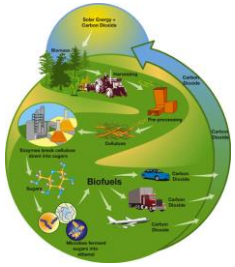
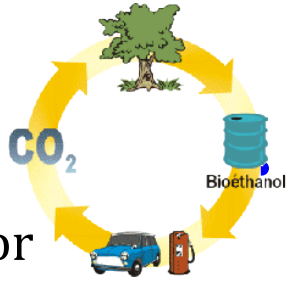


Fuels: Process

Catalysts for Fuels

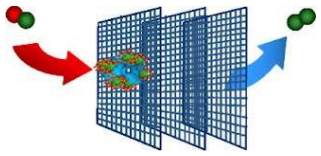
- **Photocatalyst** for water-splitting: advanced methods of catalyst preparation; microphotoreactor design; simulation and optimization
- **Graphene** for polluted air/water treatment; hydrogen production and desalination, testing, optimization
- **Zeolites** from industrial/agricultural waste for triglyceride cracking
- **Enzymes** for transesterification, fermentation, pretreatment





Reaction & Separation Engg

- **Photoreactor and Microphotoreactor Design, fabrication & Testing**
- **Membrane** to increase HV of biogas
- **Simultaneous Enzymatic Pretreatment, Hydrolysis & Fermentation** for higher productivity
- **Hydrogen Storage** for faster discharge
- **Advanced Technologies** gamma ray, ultrasonication, ozonation



Fuels: Past Works

2012 2nd International Conference on Environment and Industrial Innovation
IPCBEE vol.35 (2012) © (2012) IACSIT Press, Singapore

Continuous Bioethanol Production Using *Saccharomyces cerevisiae* Cells Immobilized In Nata De Coco (Biocellulose)

Charlimagne M. Montealegre, Emerson R. Dionisio, Lawrence V. Sumera, Jay R T. Adolacion and Rizalinda L. De Leon[+]

Biochemical Engineering Laboratory, Department of Chemical Engineering, College of Engineering, University of the Philipines, Diliman, Quezon City 1101 Philippines

Abstract. The performance of Nata de coco (NDC) and Calcium alginate (CA) as an immobilization medium for *Saccharomyces cerevisiae* cells are compared in terms of production rate and conversion. *S. cerevisiae* cells are immobilized in NDC and CA beads using a cell suspension with an average approximate live cell density of 232.1288 ± 1.5387 cells/mL. The biocatalysts NDC and CA are charged into horizontal fermentation reactors. A centrifugal pump and manifold is used to control the flow rate to a desired flow rate of 9 mL/hr. Samples are collected every 12 hours and tested for ethanol by gas chromatography and glucose concentration by colorimetry. The average steady state effluent ethanol concentration, productivity and conversion in NDC are 5.093 % by volume, 52.329 mL/hr and 0.7779, respectively. One-way ANOVA showed that the immobilization medium has a significant effect on the parameters under consideration. T-test is further performed between NDC and CA biocatalysts which showed that effluent ethanol concentration, productivity and conversion of NDC and CA are statistically equal. The study showed that the NDC biocatalyst performs equally well in the conditions optimized for CA biocatalyst. The structural strength and cost effectiveness of Nata de Coco makes it a very promising immobilization medium for continuous bioethanol production.

Keywords: Immobilization, Biocellulose, Calcium Alginate, Continuous Fermentation, Horizontal Reactor, Baker's Yeast

Fuels: Past Works

Renewable and Sustainable Energy Reviews 15 (2011) 4432–4435

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Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Bioethanol production from farming non-food macroalgae in Pacific island nations: Chemical constituents, bioethanol yields, and prospective species in the Philippines

M.G. Borines[a,*], R.L. de Leon[b], M.P. McHenry[c]

[a] College of Engineering and Agro-industrial Technology, University of the Philippines, Los Baños, College, 4031 L
[b] College of Engineering, University of the Philippines, Diliman, Quezon City, Philippines
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Keywords:
Renewable biofuel
Bioethanol
Mariculture
Macroalgae
Sargassum spp.

ABSTRACT

Increasing biofuel production on agricultural la
deforestation [1], and also inflate food pric
Philippines [2–4]. Compounding problems as
countries are the technical efficiencies of bioetl
restrial crops that are close to, or less than unit
As the increase in terrestrial biofuel production
is publically stated, alternative feedstocks are
while reducing the negative ecological and foc
of farmed macroalgae chemical substrates as
bioethanol yields, and details prospective non-
region. Leveraging off the existing capability o
wet tonnes annually in the Philippines alone)
ulated by bioethanol producers can be develo
feedstocks.

Quim. Nova, Vol. XY, No. 00, 1-5, 200_

CHARACTERIZATION AND CATALYTIC PERFORMANCE OF POTASSIUM LOADED ON RICE HUSK SILICA AND ZEOLITE NaY FOR TRANSESTERIFICATION OF JATROPHA SEED OIL

Kathrina D. Montalbo and Rizalinda L. de Leon
Department of Chemical Engineering, College of Engineering, University of the Philippines, Quezon City, 1101, Philippines
Onsulang Sophiphun, Saowanee Manadee, Sanchai Prayoonpokarach and Jatuporn Wittayakun*
School of Chemistry, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand

Recebido em 22/11/12; aceito em 29/4/13; publicado na web em 17/7/13

Artigo

Rice husk silica (RHS) and NaY were used as supports for potassium (K) prepared from acetate buffer (B) and acetate (A) solutions. K loading did not destroy the NaY structure, but it caused a decrease in the surface area; the K species resided in micropores and on the external surface. In contrast, K loading resulted in the collapse and a decrease in the surface area of RHS. It was found that 12K/NaY-B was the most active catalyst for the transesterification of Jatropha seed oil. The minimum K content in K/NaY-B that provided complete conversion of the Jatropha seed oil was 11 wt%, and the biodiesel yield was 77.9%.

Keywords: zeolite NaY; potassium; Jatropha seed oil.

INTRODUCTION

Climate change issues, increasing oil prices, and the exhaustion of fossil fuel resources are the main reasons why researchers focus on the development of renewable energy sources and their utilization. One of the renewable energy sources that is being tapped by most countries is biofuel because the transport sector is the largest emitter of pollutants to the atmosphere. Biodiesel is considered as an attractive substitute for petroleum-based diesel fuel because it is an

Herein, the results of a comparison of the characteristics and catalytic performance of 12 wt% potassium loaded on different supports (rice husk silica (RHS) and NaY) as catalysts for the transesterification of Jatropha seed oil are reported. Potassium acetate (A) and potassium acetate buffer (B) were used as the active species precursors in order to determine the effect of the potassium precursor on the activity of the catalyst. In addition, the minimum amount of potassium necessary to achieve complete conversion of Jatropha seed oil to biodiesel was determined.

Fuels: Past Works

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journal homepage: www.elsevier.com/locate/jpowsour

Ultrafast and stable hydrogen generation from sodium borohydride in methanol and water over Fe–B nanoparticles

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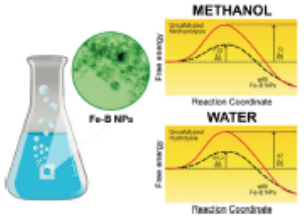
[a] *Electrochemical Reaction and Technology Laboratory, School of Environmental Science and Engineering, Gwangju Institute of Science and Technology (GIST), Gwangju 500-712, Republic of Korea*
[b] *Department of Chemical Engineering, College of Engineering, University of the Philippines Diliman, Quezon City 1101, Philippines*
[c] *Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, Berlin D-14195, Germany*

HIGHLIGHTS

- Optimized synthesis conditions for Fe–B nanoparticles with high hydrogen generation rates.
- Ultrafast and sustained H_2 generation rates in methanol solutions.
- Low activation energy values for $NaBH_4$ hydrolysis (64.26 kJ mol^{-1}) and methanolysis (7.02 kJ mol^{-1}) over Fe–B NPs.

GRAPHICAL ABSTRACT



ARTICLE INFO

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ABSTRACT

Use of environmentally friendly hydrogen as fuel on a massive scale requires efficient storage and generation systems. Chemical hydrides, such as sodium borohydride ($NaBH_4$), have the capacity to meet these needs as demonstrated by its high hydrogen storage efficiency. Here, we first report the catalytic activity of Fe–B nanoparticles supported on porous Ni foam – synthesized *via* a simple chemical reduction technique – for hydrogen generation from the mixtures of $NaBH_4$, H_2O, and CH_3OH. Activation energies of the catalyzed hydrolysis (64.26 kJ mol^{-1}) and methanolysis (7.02 kJ mol^{-1}) are notably lower than other metal-boron catalysts previously reported. Methanol, in combination with a cheap but highly

THE OXIDATIVE DESULFURIZATION OF FUELS WITH A TRANSITION METAL CATALYST: A COMPARATIVE ASSESSMENT OF DIFFERENT MIXING TECHNIQUES

Ming-Chun Lu[1], Luisa Cyd Charisse Biel[2], Meng-Wei Wan[3], Rizalinda de Leon[4], and Susan Arco[5]

[1] *Department of Environmental Resources Management, Chia-Nan University of Pharmacy and Science, Tainan, Taiwan*
[2] *Environmental Engineering Graduate Program, University of Philippines-Diliman, Quezon City, Philippines*
[3] *Department of Environment Engineering and Science, Chia-Nan University of Pharmacy and Science, Tainan, Taiwan, R.O.C.*
[4] *Department of Chemical Engineering, University of Philippines-Diliman, Quezon City, Philippines*
[5] *Institute of Chemistry, University of Philippines-Diliman, Quezon City, Philippines*

In this study, oxidative desulfurization of sulfur compounds using hydrogen peroxide, phosphotungstic acid, and phase-transfer agent using high-intensity probe ultrasonication, and high shear mixer was investigated. The effect of agitation speed (7600–14,000 rpm), reaction temperature (50–70°C), and treatment time (10–30 min) on sulfur conversion was examined and optimized using response surface methodology. A box-behnken design was employed to determine the significance of various process parameters and their interactions using analysis of variance. Analytical results for the model sulfur compounds by ultrasound-assisted oxidative desulfurization and high shear showed comparable results. Both treatment systems provided a 98% conversion of dibenzothiopene and benzothiopene to polar sulfones at 70°C in 30 min. In both systems, the experimental data followed the pseudo-first-order equation with activation energy of 60 kJ°mol. Results indicate that ultrasound energy produce greater reaction rates when compared to mixing with no significant difference in activation energy. In addition, the advantages and drawbacks of ultrasound-assisted extraction with respect to the high shear oxidative desulfurization were discussed.

Keywords: *Benzothiophene; Box-behnken design; Dibenzothiophene; High shear mixer; Ultrasound-Assisted oxidative desulfurization*

Department of Chemical Engineering
University of the Philippines-Diliman

Fuels: Past Works

Best Poster
3rd ERDT Congress

Growth, Lipid Content, and Lipid Profile of the Green Alga, *Chlorella vulgaris* Beij., Under Different Concentrations of Fe and Co_2

Rowena B. CARPIO[1,*], Rizalinda L. De LEON[1], and Milagrosa R. MARTINEZ-GOSS[2]
[1]University of the Philippines Diliman; [2]University of the Philippines Los Baños

Abstract

This study describes the effects of different concentrations of Fe^{+3} in the growth medium (2.4E-05 mol/ L and 4.8E-05 mol/L as Ferric citrate) and CO_2 (0.036%, 1% and 2% as CO_2 in air) on the growth, total lipid (TL) content, total lipid production (TLP) and fatty acid (FA) profile of an indigenous green algal strain, *Chlorella vulgaris* Beij., in vitro. Results showed increasing trend for algal growth, and decreasing trend for the algal TL content under 4.8E-05 mol Fe^{+3}/L (hi-Fe) with increasing CO_2. Generally, Fe^{+3} augmentation improved the tolerance and carbon fixation of microalgae under elevated CO_2 in aeration up to 2%. All the lipids obtained displayed FA profile suitable for biodiesel production, but the lipid from 2.4E-05 mol/ L (lo-Fe) with 2% CO_2 gave superior fuel property, in terms of iodine value, cetane number and viscosity which satisfies the specifications both by the European (EN 14214) and US (ASTM B100) standards. The study also showed the possibility of manipulating the fatty acid composition in green algae using Fe and CO_2, to suit various application.

Introduction

The necessary technology for the production of profitable microalgae-based biodiesel is still in various states of development. About 60 - 75% of the cost of algae oil is due to the algal growth. One approach that has been suggested to reduce the input costs of microalgae cultivation is the direct utilization of CO_2 from flue gases. However, not all microalgae species can tolerate high-CO_2 condition or result to the production of high biomass and valuable lipid yield.

Results

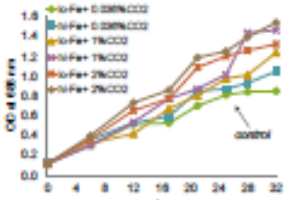


Figure 3. Growth response of C. vulgaris under different concentrations of Fe^{+3} & CO_2. Significant at $P < 0.1000$ for $n = 3$.

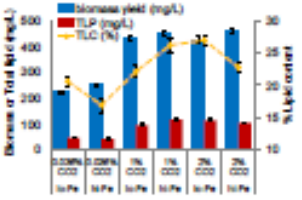


Figure 4. Dry biomass yield, total lipid content (TLC) and total lipid production (TLP) of C. vulgaris under different concentration of Fe^{+3} & CO_2. Lo-Fe = 2.4E-05 mol Fe^{+3}/L, hi-Fe = 4.8E-05 mol Fe^{+3}/L, $P< 0.1000$, $n = 3$.

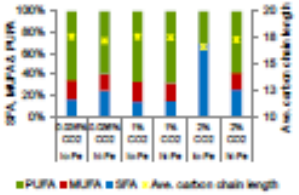


Figure 5. GC-MS fatty acid composition of FAME as saturated fatty acid (SFA), mono-unsaturated fatty acid (MUFA), & polyunsaturated fatty acid; and ave. carbon chain length under different concentration of Fe^{+3} & CO_2.

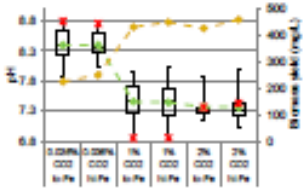
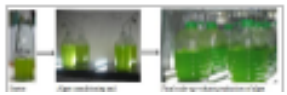


Figure 6. pH versus dry biomass of C. vulgaris grown at different concentration of Fe^{+3} & CO_2, $P < 0.1000$, $n = 3$.

- Algae growth significantly improved ($P<0.100$) with elevated CO_2 and/or Fe supp. compared to the control (Fig 3 & Fig. 4).
- Doubling days shortened from 8.68 to 7 days.
- Control entered the stationary phase at day 28, the rest continued to grow at exponential rate, up to the final culture day (Fig 3).
- Highest dry biomass yield (460.0 ± 10 mg/L) from hi-Fe with 2% CO_2 (Fig. 4).
- Highest TLC (27.0 ± 0.8%) from lo-Fe with 2% CO_2. The interaction of Fe and CO_2 had sig. effect on TLC ($P < 0.1000$) (Fig. 4).
- Highest TLP (116.4 ± 5.4 mg/L) obtained from two culture conditions: hi-Fe with 1% CO_2 & lo-Fe with 2% CO_2 (Fig. 4).
- All lipids obtained has fatty acid profile suitable for biodiesel production (Fig 5).
- Lipid profile remarkably changed with 2% CO_2.(Fig. 5)
- Lipid from lo-Fe with 2% CO_2 displayed the highest amount of %SFA and shortest carbon chain length (Fig. 5) and superior fuel property in terms of iodine value, cetane number and viscosity that satisfy both the European (EN 14214) and US (ASTM B100) standards.

Methods

- *C. Vulgaris*: obtained from the Institute of Biological Science, UP Los Banos.



Discussion

- The growth of algae significantly increased under elevated CO_2 because the pH of the culture were brought down to around 7 (Fig. 6), resulting from the conversion of excess or unutilized CO_2 gas to H_2CO_3. This narrows the pH gradient between the growth medium and pH neutral intracellular fluid in algae, thus facilitating an easier uptake of CO_2 into the algae cells via simple diffusion (Ricardo et. al.

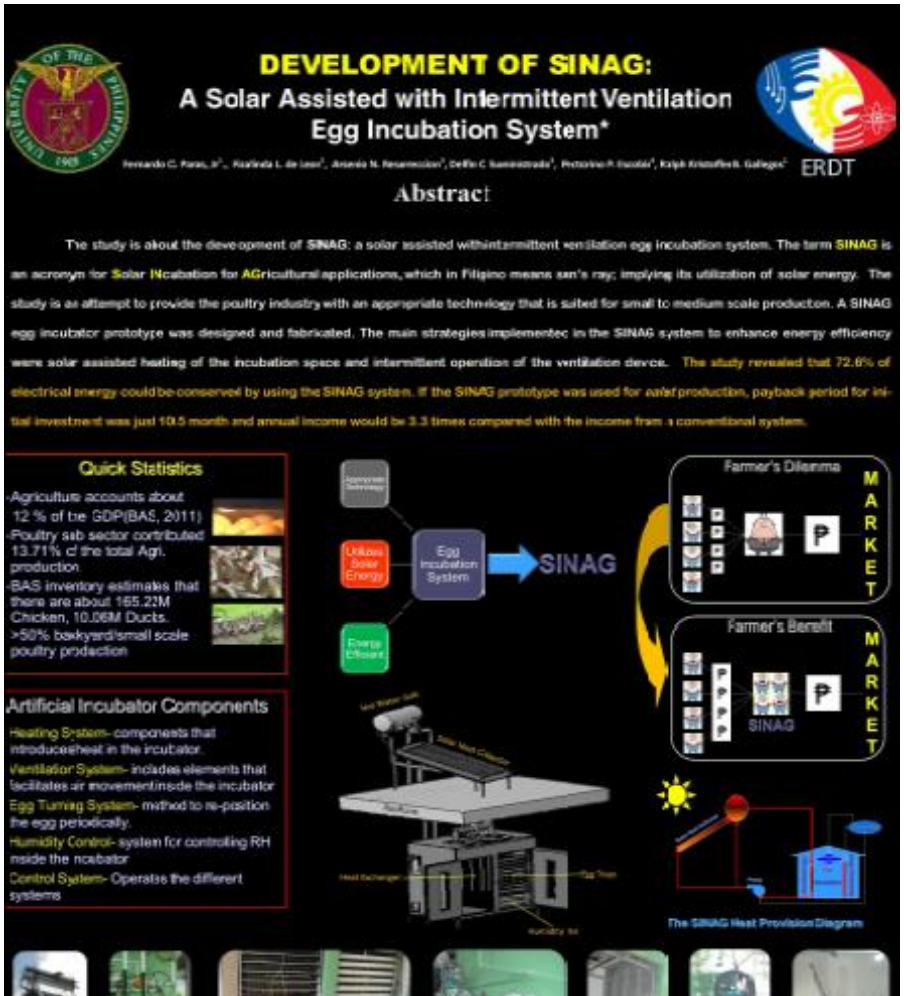
Conclusion

- Fe^{+3} augmentation could be a viable strategy to improve the tolerance of *C. vulgaris* under moderately high CO_2 (up to 2%) aeration.
- The interaction of Fe^{+3} (as Ferric-citrate) and CO_2 in the medium and aeration, respectively significantly influenced the lipid accumulation in *C. vulgaris*.

Energy

- Solar
  - Thermal Analysis of PV
  - Solar-assisted Egg Incubator
- Geo thermal
  - Geothermal Wellbore Simulation
- Biomass
  - Model continuous downdraft carbonizer

Energy: Past Works



DEVELOPMENT OF SINAG:
A Solar Assisted with Intermittent Ventilation Egg Incubation System*

ERDT

Fernando C. Paras, Jr.[1], Rizalinda L. de Leon[2], Arsenio N. Resurreccion[3], Delfin C. Suministrado[3], Petronino P. Escalo[3], Ralph Kristoffer B. Gallegos[2]

Abstract

The study is about the development of SINAG: a solar assisted withintermittent ventilation egg incubation system. The term SINAG is an acronym for Solar INcubation for AGricultural applications, which in Filipino means sun's ray; implying its utilization of solar energy. The study is an attempt to provide the poultry industry with an appropriate technology that is suited for small to medium scale production. A SINAG egg incubator prototype was designed and fabricated. The main strategies implementec in the SINAG system to enhance energy efficiency were solar assisted heating of the incubation space and intermittent operation of the ventilation device. The study revealed that 72.6% of electrical energy could be conserved by using the SINAG system. If the SINAG prototype was used for *balut* production, payback period for initial investment was just 10.5 month and annual income would be 3.3 times compared with the income from a conventional system.

Quick Statistics

-Agriculture accounts about 12 % of the GDP(BAS, 2011)
-Poultry sub sector contributed 13.71% of the total Agri. production
-BAS inventory estimates that there are about 165.22M Chicken, 10.06M Ducks.
>50% backyard/small scale poultry production

Artificial Incubator Components

-Heating System- components that introduces heat in the incubator.
Ventilator System- includes elements that facilitates air movement inside the incubator
Egg Turning System- method to re-position the egg periodically.
Humidity Control- system for controlling RH inside the incubator
Control System- Operates the different systems

Egg Incubation System
SINAG
Farmer's Dilemma
Farmer's Benefit
MARKET
MARKET
SINAG

The SINAG Heat Provision Diagram

UNIVERSITY OF THE PHILIPPINES

Master of Science in Energy Engineering

Mario L. Buhali Jr.

Thermodynamics – Based Method for Estimating Solar PV Yield Using Philippine SSE and PV Performance Parameters

Thesis Adviser:
Dr. Rizalinda L. de Leon
Energy Engineering Graduate Program
University of the Philippines Diliman

Date of Submission
15 April 2012

Author's Copy, suggested citation: Orge R, McHenry MP & de Leon RL (2013) Modelling the carbonization process to develop a cost-effective, smokeless, continuous, down-draft rice husk carbonizer suitable for rice growing regions. In: Renewable energy: economics, emerging technologies and global practices. Ed. Poullikka A. Nova Science Publishers, Hauppauge, New York, USA. ISBN 978-1-62618-264-6.

Book Chapter

Modeling the carbonization process to develop a cost-effective, smokeless, continuous, down-draft rice husk carbonizer suitable for rice growing regions.

R. F. Orge[a*], M. P. McHenry[b], and R. L. de Leon[c]
[a]Philippine Rice Research Institute (PhilRice), Philippines, [b]School of Engineering and Energy, Murdoch University, Western Australia, [c]College of Engineering, University of the Philippines, Diliman, Philippines.

Abstract

This work discusses modeling of the operational processes occurring in a small-scale, down-draft, continuous rice husk (40 kg h^{-1}) carbonizer suitable for application in poor rice growing regions. The model was used as a tool to optimize the performance of a constructed carbonizer using material and heat balances. The carbonizer technology operating principles are discussed in terms of four operational "zones" and the possible reactions occurring in each zone. The material balance model was used to determine the amounts of each participating material at each zone, and the energy balance was generated using the material balance solutions. The final output of the model for O_2, CO, and CO_2 was reconciled with testing performance of the constructed carbonizer. The results suggested that 99.2% (weight basis) of the total CO produced during carbonization was burnt at the ignition chamber zone, resulting in only 0.8% CO emission from the chimney. The energy balance determined there was a high potential for the carbonizer to produce useful heat, for rice farm activities, with flue gasses calculated at 724°C. The material and heat balance models were successfully verified by prototype testing.

Keywords: *Carbonizer; Rice husk; Energy; Model; Biochar.*

Energy: Past Works

Author's Copy, suggested citation: Orge R, McHenry MP & de Leon RL (2013) Emission reduction theory and results in the development of a suitable small-scale, portable, continuous rice husk carboniser for poor rural regions in transitional economies. In: Charcoal: chemical properties, production methods and applications. Ed. Tyrone EN. Nova Science Publishers, Hauppauge, New York, USA. ISBN 978-1-62808-664-5. p.33-60.

EMISSION REDUCTION THEORY AND RESULTS IN THE DEVELOPMENT OF A SUITABLE SMALL-SCALE, PORTABLE, CONTINUOUS RICE HUSK CARBONISER FOR RURAL REGIONS IN TRANSITIONAL ECONOMIES.

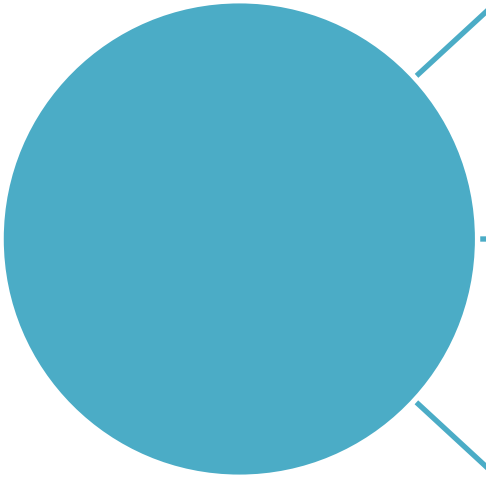
Ricardo F Orge[1*] Mark P McHenry[2] Rizalinda L de Leon[3]

[1] Philippine Rice Research Institute (PhilRice), Maligaya, Muñoz Science City, 3119 Nueva Ecija, Philippines. Tel. (+63) (44) 456-0258 (rforge@gmail.com). [2] School of Engineering and Information Technology, Murdoch University, Western Australia. [3]College of Engineering, University of the Philippines Diliman, Quezon City, Philippines.

ABSTRACT

This chapter describes the process of developing a new rice husk conversion technology suitable to the local requirements of rice farmer in poor rural areas of the Philippines. The small-scale, portable, continuous carboniser was designed to enable heat extraction applications (crop drying, steam generation, etc.), while maintaining conversion effectiveness, with a special focus on the reduction of rural workplace carbon monoxide and smoke emissions. The chapter contains the technology optimisation model methodology which aimed to achieve high operating temperatures for heat extraction, highest fixed carbon content of rice husk biochar, and the lowest emissions of carbon monoxide possible during the carbonisation process. A Response Surface Methodology was used to develop predictive models relating carboniser performance parameters (airflow rate, temperature, biochar quality, carbon monoxide emission data) to the carboniser parameters (chimney diameter and ignition chamber opening). The analysis of variance showed the importance of the chimney diameter relative to the ignition chamber opening in determining overall performance. The highest temperatures, lowest CO emissions, were associated with the highest airflow rates, although proximate analysis of the biochar samples showed there was no influence of the relative sizes of the chimney and ignition chamber on the biochar fixed carbon content. Therefore, the selection of the optimal carboniser chimney and ignition chamber sizes were based solely on temperature and CO emissions.

Thermal Systems



PCM

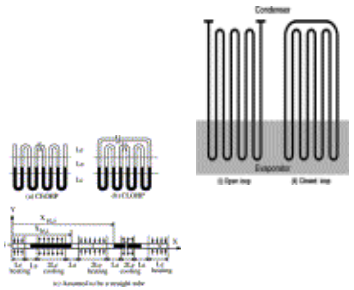
- Synthesis
- Micro encapsulation
- Characterization

Nano fluids

- Synthesis
- Characterization

Heat Pipes

- Performance
- Modeling



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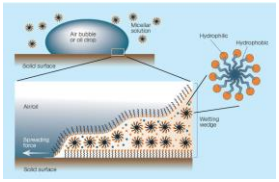
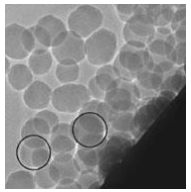
Thermal Systems

NANO FLUIDS

- **Better conductors**: synthesis (and stabilization), characterization & performance in oscillating heat pipes, heat exchangers
- **Better heat transfer:** oscillating heat pipes





PHASE CHANGE and INSULATION MATERIALS

- **Fatty acid PCMs:** synthesis, characterization, thermal degradation studies, application
- **Insulation and PCM Microencapsulation:** from biomaterials (e.g. water hyacinth) and crude raw materials (e.g. glycerine)

Department of Science and Technology

Science Education Institute

Design of a Methyl Laurate – Methyl Myristate PCM Storage System to Support a Solar Vapor-Compression Chiller

Rommel N. Galvan, Rizalinda R. de Leon & Maria Natalia R. Dimaano

Abstract

Binary mixture consisting 80% by volume methyl myristate and 20% methyl laurate was used as phase change material (PCM) for a design to support a generic solar vapor-compression chiller. The experimental melting point and latent heat of the mixture obtained from differential scanning calorimetric analysis (DSC) is 9.8°C and 215.24kJ·kg^{-1}, respectively. A shell and tube heat exchanger design was employed to hold 44.5 kg of the PCM mixture. A 20-footer intermodal container van was used to simulate a controlled room.

A laboratory chiller and PCM heat exchanger were used by the system to cut off the peak room temperature to 2°C during day time. The system has been proven to be economical for it lowered the energy requirement of the chiller to attain human comfort. The PCM system increased the coefficient of performance (COP) of the chiller from 7.8 to 14.2 during day time operations.

Introduction

In the past decade, the economic situation started to change because of the rising energy prices. The energy demand that ensures a comfortable environment for humans in buildings has increased worldwide and especially the use of electricity for cooling and air-conditioning is rising fast. Cooling and air-conditioning often cause a peak in electricity demand in afternoon hours when, just because of that, peak electricity prices apply.

Current researches now focus on phase change material (PCM) because of their ability to control both temperature and heat absorption. These properties, with the aid of proper engineering may create usable equipment for low temperature energy storage, lowering the energy requirement of existing cold water chiller systems for small to medium sized cooling duties. The main focus of this study is to develop a PCM system to lower the existing energy requirement of a cooling system without compromising human comfort.

Objectives of the Study

(1) Design a cooling apparatus utilizing a PCM previously developed (Galvan, 2010).

(2) Create a simulated environment to test and examine the equipment, and

Methodology

PCM System

A rectangular box of size 1.35 m (length) x 0.25 m (width) x 0.8 m (height) was used to house 477 aluminum tubes (12.7 mm, ½ inch nominal tubing). The size of the rectangular box will allow 9 by 53 tubes using the arrangement described in figure 1. The box was thermally insulated using 50 mm Styrofoam™, with both the 0.25 x 0.8 faces torn off to allow air flow through the equipment (figure 2).

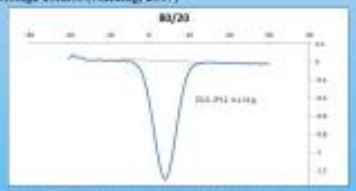
PCM mixture of 80% by volume methyl myristate (MM) and 20% methyl laurate (ML) was used to fill the tubes. A total of 44.5 kg was used for this setup. A Toshiba Machine LT DK70 is used as the water chiller for the setup. A fabricated evaporator with two cooling fans was attracted to this chiller, which was attached to the back of the PCM box.

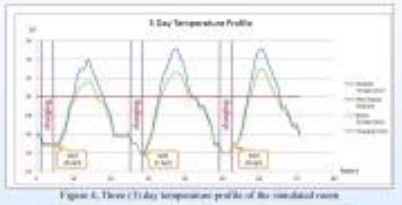
Simulated Environment

A 20 footer container van was used to simulate a room. The van was insulated from the inside by 50 mm Styrofoam™, and the outside wall was painted flat white. Two (2) thermocouples were placed, one 1 meter away from the outside wall of the van, the other within the dead center of the van. Temperatures were logged using Fluke Hydra 2635A. The evaporator and the PCM box was placed inside the van with the chiller placed outside. Two (2) insulated 1 inch copper pipes connect the chiller with the evaporator. The operation of the fan and the chiller was controlled using a thermostat. The chiller was also controlled during PCM charging hours.

Results

Differential scanning calorimetry (DSC) suggest that the 80/20 MM-ML mixture has a melting point just below 10°C making it applicable for low temperature energy storage (figure 3). Furthermore, the enthalpy of fusion of 215 kJ/kg makes the mixture suitable for storage control (Mehling, 2007)





Conclusion

The experiment setup proves the feasibility of using a PCM with a melting point of below 10°C to be used as a temperature controlled accessory to lower the energy requirements of a conventional water chiller for room space cooling. There is a significant increase in the coefficient of performance of the chiller from its normal operating condition, than that of the system which included the PCM mix. Furthermore, the use of the PCM mix cuts the time needed to operate the water chiller to perform space cooling for the simulated room.

Recommendation

The initial test concentrated only on the discharge phase of the chiller PCM setup. The authors will need to determine if there are significant effects on the space cooling capability of the system if the charging phase were also tested or optimized.

Furthermore, the study focuses on the attainment of human comfort levels with respect to space cooling. Cabeza, Mehling, Hiebler, and Ziegler (2002) discussed the parameters to attain human comfort as the temperature

Essential Chemicals

- **Peptone:** from chicken feathers
- **Pectin:** from banana peel

- **Omega Fatty acids** from microalgae
- **Bioactive compounds** in salt farm mud residue
- **Anti melanogenesis** compounds in bagasse

Sustainable Systems

- **Carbon Capture:** 2-stage limestone contactor
- **Ethanol pollution reduction:** Catalytic ethanol oxidation
- **Sustainable Wellness:** Carotid artery modeling, Bioactive stent coating

Sustainable Systems

Effect of Gas to Liquid Ratio (G/L), Superficial Velocity (U_S), Limestone Particle Size (d), and Height to Diameter Ratio (H/D) to the Capture of CO_2 in an AWL Reactor

Ricardo T. Villavert[1], Rizalinda L. de Leon[2], Karl Ezra S. Pilario[2]

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[2] Chemical Engineering Department, University of the Philippines - Diliman, Quezon City, Phil

ABSTRACT

Studies have shown that climate change is caused primarily by increasing carbo (CO_2) levels in the atmosphere. Carbon Capture and Storage (CCS) is one of the a being taken to address the problem by capturing CO_2 from large point sources a instead of releasing. AWL (Advanced Weathering of Limestone) is an eco promising CCS technology where CO_2 is absorbed in the mixture of limestone an produce an effluent beneficial to the growth of calcifying marine organisms.

To augment the gap in previous studies, this research determined the effect of Gas Ratio (G/L), superficial velocity (U_S), limestone particle size (d), and column diameter ratio (H/D) to the capture of CO_2 in an AWL reactor system. A model b chemical equilibrium relationships and limestone contactor designs was devel validated experimentally.

The model predicted within the region of low U_S, low G/L, high H/D and a low d v capture is highest.

Artigo

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PROPERTIES OF SILICA FROM RICE HUSK AND RICE HUSK ASH AND THEIR UTILIZATION FOR ZEOLITE Y SYNTHESIS

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Department of Chemical Engineering, College of Engineering, University of the Philippines, Quezon City, 1101, Philippines
Kamolwan Rintramee, Sanchai Prayoonpokarach and Jatuporn Wittayakun*
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Recebido em 21/12/10; aceito em 22/3/11; publicado na web em 10/6/11

This study compared properties of silica (SiO_2) from rice husk (RH) and rice husk ash (RHA) extracted by acid- and heat-treatment. The SiO_2 from RH was in amorphous phase with nearly 100% purity while that from RHA was in crystalline phase with 97.56% purity. Both extracted SiO_2 were used in the synthesis of zeolite NaY but that from RH was better due to the efficiency in product recovery and simplicity of extraction. After the NaY was exchanged to NH_4Y and calcined to convert to HY, the product did not carry over the textural properties of the parent NaY and NH_4Y.

Keywords: silica; rice husk; rice husk ash.

INTRODUCTION

Zeolite Y is a type of zeolite in faujasite family and widely known for its use as an adsorbent and as catalyst.[1] It is also commonly used as a catalyst support because of its thermal stability and acidity.[2,3] Zeolite Y can be synthesized by using various sources of silica (SiO_2). A range of commercial silica sources are available varying from compound, fumed and colloidal forms.[3] We previously reported the synthesis of zeolite Y in sodium form (NaY) by using silica from rice husk (RH).[4] Because of the abundance of rice husk ash (RHA) generated x-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive x-ray spectroscopy (EDS), and N_2 adsorption-desorption analysis. Moreover, the stability of the zeolite upon transformation to ammonium form (NH_4Y) by ion exchange and to proton form (HY) after a subsequent calcination was also reported.

EXPERIMENTAL

Chemicals and materials

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FETS

Sustainable Systems

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ICBET 2013: May 19-20, 2013, Copenhagen, Denmark

Carotid Artery Modeling Using the Navier-Stokes Equations for an Incompressible, Newtonian and Axisymmetric Flow

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[b]Laboratory of Nanomedicine and Biomaterials, Harvard Medical School, 75 Francis St.,Boston MA 02115, USA

Abstract

This paper describes two-dimensional (2D) structural and hemodynamics model of the carotid artery using computational software (CS). The Arbitrary Lagrangian Eulerian (ALE), which was introduced system, was utilized as a numerical technique. The structural modeling of the carotid arteries about was constructed from computed tomography (CT) scans using computer-aided design (CAD) a formulation was used for the structural domain. The blood was considered as an incompressible N Eulerian reference was applied for its domain. Coupling of the reference systems was carrie computational grid permitting numerical modeling of hemodynamics as governed by 2D incompressible Navier-Stokes equations (NSE). The results for hemodynamic simulations were physiological blood velocity obtained using the Doppler ultrasound instrument.

Selection and peer-review under responsibility of Asia-Pacific Chemical, Biological & Environmental Engineering

Keywords: CARDIOVASCULAR MODELLING, CT SCAN, FINITE ELEMENT METHOD, HEMODYNAMICS

World Academy of Science, Engineering and Technology
Vol:77 2013-05-27

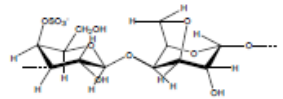
Effects of Irradiation to Morphological, Physicochemical and Biocompatibility Properties of Carrageenan

Jhalique Jane R. Fojas, Rizalinda L. De Leon, and Lucille V. Abad

***Abstract*—**The characterization of κ-carrageenan could provide a better understanding of its functions in biological, medical and industrial applications. Chemical and physical analyses of carrageenan from seaweeds, *Euchema cottonii L.*, were done to offer information on its properties and the effects of Co-60 γ-irradiation on its thermochemical characteristics. The structural and morphological characteristics of κ-carrageenan were determined using scanning electron microscopy (SEM) while the composition, molecular weight and thermal properties were determined using attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR), gel permeation chromatography (GPC), thermal gravimetric analysis (TGA) and differential scanning calorimetry (DSC). Further chemical analysis was done using hydrogen-1 nuclear magnetic resonance (1H NMR) and functional characteristics in terms of biocompatibility were evaluated using cytotoxicity test.

***Keywords*—**Biocompatibility, carrageenan, DSC, FTIR, GPC, irradiation, NMR, physicochemical, SEM, TGA.

D-galactose. The commercial carrageenan are normally divided into κ-carrageenan, ι-carrageenan and λ-carrageenan (Fig.1) depending on the number and position of the sulfate group, and has a molecular mass ranging from 400-600kDa [4]. Other carrageenan units include χ, β, μ and υ-carrageenan. The μ and υ-carrageenan are modifiable to κ and ι-carrageenan in alkali conditions, imparting a higher degree of regularity to the molecule through the formation of 3,6-anydrogalactose bridge[5].



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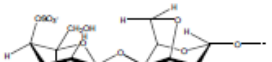

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University of the Philippines-Diliman

Bio-refineries: Fuels & High-Value Products from Agricultural, Marine and Processing Residue

Rizalinda L. de Leon, Ph.D.

Past Research on Products from Residues

- ***Myra Borines*, Bioethanol from Macroalgae (Seaweed)**
- ***John Tamargo*, Photolipid extraction from *Nannochloropsis sp.***
- ***Le Duy Khuong*, Bioethanol via Consolidated Bioprocessing from Sugarcane Bagasse**
- ***Le Duy Khuong*, Bioactivity of the extracts from sodium hydroxide pretreatment waste water with anti-melanoma inhibitory and anti-bacterial activity**
- ***Le Duy Khuong*, Crysophanol and pachybasin, two anthraquinone derivatives with melanin biosyntheis inhibitory activity from sugarcane bagasse**

Fuels, Thermal Fluids and Raw Materials: Characterization

Properties

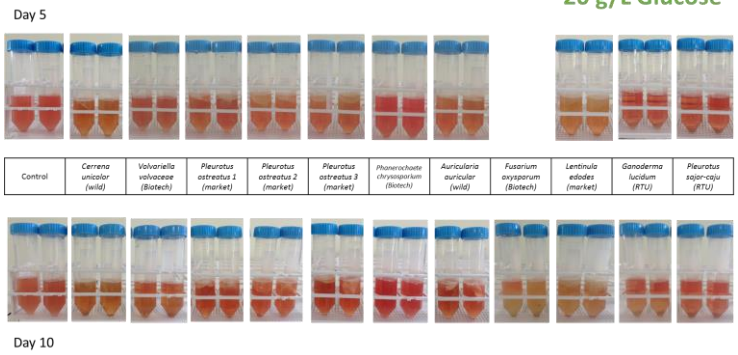
- Density
- Heating Value
- Flash Point
- Heat Capacity
- SEM
- Thermal Conductivity

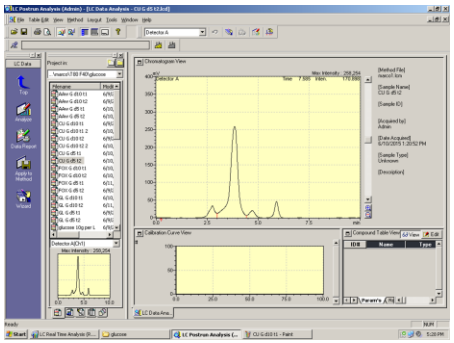
Analysis & Yield

- HPLC (CEAL)
- GC TCD (CEAL)
- GC FID (Dr. Rollon)
- GC MS (CEAL)
- Kjeldahl Analyzer
- Karl Fischer
- FTIR
- TGA

Fuels: Current Thrust

- Screening of Filamentous Fungi for ability to ferment cellulose to ethanol





Cerrena unicolor (wild)

2015 and onwards Research

Optimization of Bioethanol Production by CBP using fungus from current screening study

Study of mechanisms and kinetics of photocatalytic hydrogen production from saltwater

Microfluidic photocatalytic reactor design, optimization and testing

Department of Chemical Engineering
University of the Philippines-Diliman

Fuels, Energy & Thermal Systems Laboratory

http://dche.coe.upd.edu.ph/research-groups/fuels-energy-and-thermal-systems-laboratory/

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