ChemPor 2011

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FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO

ORDEM DOS ENGENHEIROS

PLENARY LECTURES

Process intensification

Recent Advances in Energy-Based Intensification of Chemical Reactions: Can We Control Molecules Better?
PL1
Andrzej Stankiewicz

Entrepeneurship and inovation
PL2
Roger-Marc Nicoud

Energy and sustainability
PL3
Wolfgang Arlt

Biopolymer-mediated intracellular transport for drug delivery and human cell cryopreservation
PL4
Nigel Slater

Forest based biorefineries: Role of catalysis and reaction engineering
PL5
Dmitry Yu. Murzin

New Models in Engineering Education
ST
Sebastião Feyo de Azevedo

KEYNOTE PRESENTATIONS

The two alternative mechanisms of catalytic carbon formation – relevance of kinetic linearity, surface duality and nano-geometry
KN1-CM
L. Sousa Lobo

Mechanism of Catalytic Carbon gasification: Chemical Engineering at Nano Scale. The case of CO_2 with Fe, Cu, Mg, V and their Alloys
KN1-CM part II
L. Sousa Lobo, S.A.C. Carabineiro

Molecular Simulation as a Prediction and Design Tool in Chemical Engineering
KN2-MS
M. Jorge

Towards zero energy buildings: photovoltaic and photoelectrochemical devices
KN3-EN
A. Mendes

Polymeric Biomaterials: Recent Developments
KN4-BE
M.H. Gil, P. Alves, P. Coimbra, P. Ferreira

Bioengineering strategies for *ex-vivo* cultivation and purification of stem cells
KN5-BE
J.M.S. Cabral

The Emergence of Commercial Bio-Products – Development Program at Group Portucel
KN6-BR&I
A. Gaspar, P. Sousa, J. Ataíde

ORAL SESSION - BIOLOGICAL ENGINEERING

ORAL SESSION - CHEMICAL ENGINEERING FUNDAMENTALS AND PRACTICE

Thermodynamic Analysis of Glycerol Steam Reforming for Hydrogen Production With in Situ Hydrogen and Carbon Dioxide Separation
O-FP4
J.M. Silva, M.A. Soria, L.M. Madeira

Implementation of a Simulated Moving Bed Reactor process for the synthesis of acetals: The Glycerol Ethyl Acetal case study
O-FP5
R. Faria, C. Pereira, V. Silva, J. Loureiro, A.E. Rodrigues

Purification of the Polyphenolic Fraction from *E. globulus* Bark Extract by Membrane and Adsorption Processes
O-FP6
I. Mota, P.C. Pinto, C. Pereira, J. Loureiro, A.E. Rodrigues

Optimization of the Adsorption Process for the Analytical and Preparative Separation of Nadolol Stereoisomers
O-FP7
A.E. Ribeiro, A.E. Rodrigues, L.S. Pais

Hydrogenation of Nitrobenzene over Pd/Al_2O_3 catalyst – Mechanism and effect of the main operating conditions
O-FP8
C. Sá Couto, L.M. Madeira, C.P. Nunes, P. Araújo

Heterogeneous Photocatalytic Synthesis of p-Anisaldehyde from p-Methoxytoluene in a Small Batch Reactor under UV-LED Irradiation
O-FP9
D. Heggo, H. Mohamed, S. Ookawara, Y. Matsushita

An Analysis of Ceramic Catalysts Comprised by Iron and Cobalt Oxides for the Heterogeneous Fenton's Reaction
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A.F. Rossi, R.C. Martins, R.M. Quinta-Ferreira

Mass-transfer in narrow rectangular channels with mesh-type spacers under pulsatile flow in laminar regime
O-FP11
C. Rodrigues, V. Semião, V. Geraldes

Electrochemical Impedance Spectroscopy Measurements During Chlorine-Evolution Reaction
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J.F. Silva, A.C. Dias, P. Araújo, C.M.A. Brett, A. Mendes

On the selection of the working conditions to precipitate Polystyrene wastes from Limonene solutions
O-FP13
C. Gutiérrez, J.F. Rodríguez, I. Gracia, A. de Lucas, M.T. García

Systematic Parameter Estimation for Equilibria Data With Thermodynamic Consistency Metrics and Phase Stability
O-FP14
J.F.O. Granjo, N.M.C. Oliveira, J.A.P. Coutinho

ORAL SESSION - CHEMICALS AND MATERIALS

ORAL SESSION - EDUCATION AND SOCIETY

ORAL SESSION - ENERGY

ORAL SESSION - MULTI-SCALE MODELING AND SIMULATION

ORAL SESSION - SUSTAINABILITY AND ENVIRONMENT

Industrial Waste as Catalysts in electro-Fenton-like treatment: Activity, Stability and Reusability
O-SE12
E. Alfaya, E. Rosales, M. Pazos, M.A. Sanromán

Bromate Reduction Under Hydrogen Using Monometallic Catalysts on Different Supports
O-SE13
J. Restivo, O.S.G.P. Soares, J.J.M. Órfão, M.F.R. Pereira

A Biorefinery Based on Spent Coffee Grounds: a Waste to Chemicals and Energy Solution
O-SE14
N. Caetano, V. Silva, A. Martins, T. Mata

The Role of pH and Ionic Strength in the Sorption of Vegetable Oil from Water by Cork Granules
O-SE15
A.M.A. Pintor, R.S. Souza, V.J.P. Vilar, C.M.S. Botelho, R.A.R. Boaventura

Water vapour adsorption by a coffee-based microporous carbon: effect on CO_2 capture
O-SE16
M.G. Plaza, A.S. González, F. Rubiera, C. Pevida

An overview of eggshell waste potential for sorptive and catalytic processes
O-SE17
M. Soares, M. Quina, R.M. Quinta-Ferreira

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Comparative study of Candida guilliermondii and Pichia stipitis fermentation on olive pruning dilute acid hemicellulosic hydrolysate
P-BE1
J.G. Puentes, B.G. Fonseca, S. Mateo, I.C. Roberto, A.J. Moya, S. Sánchez

Bioethanol Production: Adaptation of *Scheffersomyces stipitis* to Hardwood Spent Sulfite Liquor
P-BE2
C.J.R. Frazão, S.R. Pereira, V. Sànchez i Nogué, L.S. Serafim, M.F. Gorwa-Grauslund, A.M.R.B. Xavier

Characterisation of a Bacterium Isolated From a Minimally Processed Vegetables Plant Including its Antimicrobial Resistance
P-BE3
A. Meireles, R. Fulgêncio, I. Machado, F. Mergulhão, L. Melo, M. Simões

Bioflocculation Assessment of Mixed Cultures of Selected Microalgae and Cyanobacteria
P-BE4
A.L. Gonçalves, J.A. Loureiro, J.C.M. Pires, M. Simões

Immobilization of whole cells of *Yarrowia lipolytica* for citric acid production
P-BE5
A. Gonçalves, A. Braga, P. Ferreira, I. Belo

Development of An Image Analysis Methodology For Animal Cell Cultures Characterization
P-BE6
A.L. Amaral, D.P. Mesquita, M. Xavier, L. Rodrigues, L. Kluskens, E.C. Ferreira

Effect of Size and Oxidation in Biocompatibility of Graphene-based Materials
P-BE8
A. Pinto, G. Carolina, D. Sousa, A. Moreira, I. Gonçalves, F. Magalhães

Biorecovery of Heavy Metals Using Vermiculite for Sediment and Water Protection
P-BE9
C. Ferronato, B. Silva, F. Costa, L.V. Antisari, T. Tavares

Sucrose hydrolysis by immobilized invertase in Duolite A-568 employing a packed bed reactor
P-BE10
B.V. Cabral, L.N.S.S. Falleiros, T.S. Carmo, L.D.S. Marquez, M.M. Resende, V.L. Cardoso, E.J. Ribeiro

Use of Hardwood Sulphite Spent Liquor For Polyhydroxyalkanoate Production By Mixed Microbial Culture
P-BE11
D. Queirós, A. Fonseca, C. Rangel, S. Rossetti, L.S. Serafim

Fermentation in Two Operation Scales of Enzymatic Hydrolysates of Industrial Lignocellulosic Materials for the Production of Bioethanol
P-BE12
C.V.T. Mendes, M.G.V.S. Carvalho, J.M.S. Rocha

Influence of Different Photoperiods on Growth of the green microalgae Chromochloris zofingiensis
P-BE13
C. Silva, N. Caetano, A. Mendes

Study of the encapsulation efficiency and release profiles of alginate microspheres containing α-tocopherol
P-BE14
D. Vieira, J.S. Amaral, M.F. Barreiro

Game *tabulae* at the Convento de Cristo in Tomar – study of biological colonization
P-BE15
D.M.R. Mateus, S. da Ponte, J.P.F. Coroado, F.J.F.T. Rocha

Study of Ni (II) and Diethylketone Removal from Aqueous Solutions Using a Biofilm *of Streptococcus equisimilis* Supported on Vermiculite
P-BE16
F. Costa, B. Silva, C. Quintelas, T. Tavares

Effects of the Temperature and Broth Composition on Ethanol Production from Sugarcane Bagasse and Crude Enzymatic Extract
P-BE17
J. Fischer, V. dos S. Lopes, E.F.Q. Santos, E.J. Ribeiro, U.C. Filho, V.L. Cardoso, C.M.A. Galvão, J.C. Teodoro

Ethanol production via crude enzymatic hydrolysis of sweet sorghum bagasse treated with a pressurized batch hot water reactor
P-BE18

Immobilization of Peroxidase on Functionalized Carbon Nanotubes for the Synthesis of High Performance Biocat
P-BE41
R.M. Azevedo, J.B. Costa, C.G. Silva, A.P.M. Tavares, J.M. Loureiro, J.L. Faria

Laccase Immobilization over Magnetized Multi-Walled Carbon Nanotubes for Biocatalysis Applicati
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J.B. Costa, R.M. Azevedo, C.G. Silva, A.P.M. Tavares, J.M. Loureiro, J.L. Faria

Aerobic Granular Sludge Reactivation Performance in an Anaerobic-Aerobic Sequencing Batch Reactor After Long-term Storage
P-BE43
R.D.G. Franca, H.M. Pinheiro, N.D. Lourenço

Optimization of peptide nucleic acid fluorescence *in situ* hybridization (PNA-FISH) method for the detection of bacteria: the effect of pH, dextran sulfate and probe concentration
P-BE44
R. Rocha, R. Santos, P. Madureira, C. Almeida, N.F. Azevedo

Partial Molar Volumes of Glycine and L-Alanine in Aqueous MgSO4 Solutions between 278.15 and 308.15 K
P-BE45
C.C. Mota, O. Ferreira, S. Pinho

Improvement of the Upflow Anaerobic Sludge Blanket reactor performance for azo dye reduction by the presence of low amounts of Activated Carbon
P-BE46
R.A. Pereira, M.F.R. Pereira, M. Alves, L. Pereira

Using *Paecilomyces variotii* in a biorefinery concept to produce single-cell protein and bioethanol from hardwood spent sulphite liquor
P-BE47
T.M. Henriques, S.R. Pereira, L.S. Serafim, A.M.R.B. Xavier

High-resolution Crystal Structure Of *Colocasia esculenta* Lectin
P-BE48
P.R. Pereira, J.L. Meagher, I.J. Goldstein, V.M.F. Paschoalin, J.T. Silva, J.A. Stuckey

Determination of Native Molecular Mass and Isoforms Detection of Tarin, The GNA-related Lectin From *Colocasia esculenta*
P-BE49
P.R. Pereira, H.C. Winter, M.A. Vericimo, J.L. Meagher, J.A. Stuckey, I.J. Goldstein, V.M.F. Paschoalin, J.T. Silva

Obtaining Bacterial Cellulose Membranes with Added Starch Acetate
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V.C.R. Schmidt, F. Berti, L.M. Porto, J.B. Laurindo

***Geotrichum candidum* lipase purification using alcohol/salt-based aqueous two-phase systems**
P-BE51
W.G. Morais Jr, E.J. Ribeiro, M.M. Resende

Immobilization and Stabilization of β-galactosidase on Duolite A568 by Multipoint Attachment
P-BE52
L.N.S.S. Falleiros, W.G. Morais Júnior, B.V. Cabral, L.D. Santos, M.M. Resende, V.L. Cardoso, E.J. Ribeiro

Granulated Industrial Cork and Cork Powder as Sources of High Added-Value Chemicals
P-BE53
Y.A. Manrique, M.V. Oliveira, P. Pinto, J.M. Loureiro

POSTER SESSION - CHEMICAL ENGINEERING FUNDAMENTALS AND PRACTICE

G^E model and optimization method combinations for prediction of vapor composition in binary vle from T-x data
P-FP1
A.R. Prasad, J.S. Babji, A.A. Kumar

A comparative study on mixing rule and alpha-function combinations for correlation of binary vapor liquid equilibrium data by equation of state
P-FP2
A.R. Prasad, J.S. Babji, A.A. Kumar

Design Of Hydrogel Membranes With Embedded Magnetic Particles
P-FP3
A.C. Manjua, F.V. Chávez, P.J. Sebastião, J.G. Crespo, C.A.M. Portugal

Separation Of Human Immunoglobulin G Subclasses Using Monolith Technology
P-FP4
P. Leblebici , M.E. Leblebici , F. Ferreira-da-Silva, A.E. Ribeiro, A.E. Rodrigues, L.S. Pais

Microprotect project -The use of encapsulated essential oils for protection of stored cereals and legumes
P-FP5
C.F.Silva, J.M.Sousa, F.D.Magalhães, M.M.S.M.Bastos

Analysis of Internal Variables of a Distillation Column Operating with Distributed Control
P-FP6
G.N. Mello, R.A.F. Machado, C. Marangoni,

Catalysts Screening for the Reaction of Nitrobenzene Hydrogenation
P-FP7
C. Sá Couto, L.M. Madeira, C.P. Nunes, P. Araújo

Simultaneous Removal of CO2 and VOC using a Two Phase Partitioning Reactor
P-FP8
A. Couvert, D. Gómez-Díaz, D. López-Rivas, J.M. Navaza

CO_2 Absorption by Primary Amines: Effect of Chemical Structure and Loading upon Reaction Pathway
P-FP9
A. García-Abuín, D. Gómez-Díaz, D. López-Rivas, J.M. Navaza, A. Rumbo

Synthesis and Characterization of $ALPO_4$-17 and Evaluation of the Diffusion of n-Paraffins C10-C13 by ZLC Technique.
P-FP10
D.A.A. Gomes, S.Mattedi, M.M. Urbina, A.O.S.Silva, M. Bastos-Neto, L.A.M. Pontes

Vinasse clarification by a combined treatment of coagulation/ flocculation and adsorption
P-FP11
F.L Seixas, D.R.A. Okada, M.B. de Abreu, M.L. Menezes, S.H.B. de Faria, N.R.C. Fernandes-Machado, M.L. Gimenes

Selective Extraction of (Bio)molecules by Applying Novel Aqueous Micellar Two-Phase Systems Composed of Triton X-114 and Ionic Liquids as Co-surfactants
P-FP12
F.A. Vicente, L.P. Malpiedi, A.P. Junior, J.A.P. Coutinho, S.P.M. Ventura

Adsorption of Vanillin and Syringaldehyde by Polymeric Resins: Equilibrium adsorption studies
P-FP13
I. Mota, P.C. Pinto, J.M. Loureiro, A.E. Rodrigues

Influence of ionic liquids as electrolytes in polymer-polymer aqueous biphasic systems
P-FP14
J.H. Santos, J.A.P. Coutinho, A.Pessoa Jr., SP.M. Ventura

Chemometrics to Study the Ferric Sulphate Leaching of a Portuguese Sphalerite Concentrate
P-FP15
S.M.C. Santos, M.T.A. Reis, M.R.C. Ismael, M.J.N. Correia, J.M.R. Carvalho

Monitoring a Polyesterification Reaction by in-line Near-Infrared Spectroscopy
P-FP16
H.I. Mota, M.J.N. Correia, J.C.M. Bordado

A Comparison Study of Single-Scale and Multiscale Approaches for Data-Driven and Model-Based On-line Denois
P-FP17
R.R. Rendall, M.S. Reis

Potential use of chestnut (*Castanea sativa M.*) husk ashes as a source for potash production
P-FP18
M.D. Torres, J. Seijo

Mechanical Properties of Natural Potassium Soaps Obtained of By-products from the Chestnut Industry
P-FP19
M.D. Torres, J. Seijo

Fiber flow velocity estimation using Electrical Impedance Tomography
P-FP20
P.M. Faia, B. Branco, F. Garcia, M.G. Rasteiro

Production of chitosan microparticles cross-linked with genipin for drug release applications: A DoE approach to identify factors influencing size and shape properties
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M.J. Moura, S.P. Martins, B.P.M. Duarte

Configuration characteristics of draft tube conical spouted bed dryer for biomass treatment
P-FP22
M.J. San José, S. Alvarez, I. García

Measurements of Activity Coefficients at Infinite Dilution for Terpenes, Terpenoids and Water in Ionic Liquids
P-FP23
M.A.R. Martins, U. Domańska, B. Schröder, S.P. Pinho, J.A.P. Coutinho

Alkylimidazolium Based Ionic Liquids: Mutual Solubilities and Thermophysical Properties
P-FP24
M.A.R. Martins, C.M.S.S. Neves, K.A. Kurnia, L.M.N.B.F. Santos, M.G. Freire, S.P. Pinho, J.A.P. Coutinho

Degradation of BDE-100 in waters by direct photolysis at ppb level
P-FP25
M.S.F. Santos, A. Alves, L.M. Madeira

Systematic development of kinetic models for systems described by linear reaction schemes
P-FP26
C.S. Vertis, N.M.C. Oliveira, F.P.M. Bernardo

Can the Odor Intensity be Predicted by a Theoretical Model?
P-FP27
P. Costa, M.A. Teixeira, A.E. Rodrigues

The Effect of the Spreading Coefficient on Oxygen Mass Transfer in Gas-Liquid-Liquid systems
P-FP28
H. Pinho, H. David, S. Alves

Recovery of Copper from Sulphuric Solutions Using Hollow Fibre Liquid Membrane Processes
P-FP29
S. Agarwal, M.T.A. Reis, M.R.C. Ismael, J.M.R. Carvalho

Magnetic Classification in wet mode: Proving the concept
P-FP30
P.A. Augusto, T. Castelo-Grande, A.M. Estévez , M.A. Alves, P. Costa, D. Barbosa, M.C. Torrente

POSTER SESSION – CHEMICALS AND MATERIALS

A Calixarene-derived Poly(phenyleneethynylene) as a Thin Film Sensor for High Explosives in Aqueous Media
P-CM1
A.I. Costa, J.V. Prata

Development of Uniform Chitosan ultrathin films on Glass and Silicon Substrates
P-CM3
A.P. Carapeto, A.M. Ferraria, A.M. Botelho do Rego

Effect of Nd Doping on The Binary Perovskite Transformation in $BaCe_{1-x}Nd_xO_3$ ($0 \leq x \leq 0.3$)
P-CM4

Selective Fractionation of Corn Straw Hemicellulose Using Iron Nitrate
P-CM17
N. Santos, P. Moniz, L.C. Duarte, F. Carvalheiro

Integrated Recovery of Lignin and Hemicellulose Derived Compounds from Rice Straw
P-CM18
P. Moniz, L.C. Duarte, C. Serralheiro, L.B. Roseiro, H. Pereira, F. Carvalheiro

Oligosaccharides production from *Anonna cherimola* Mill. seeds: optimization and modelling
P-CM19
A.M. Dionísio, P.C. Branco, I. Torrado, L.B. Roseiro, F. Carvalheiro, P.C. Castilho, L.C. Duarte

Influence of Bentonite Clay Concentration and Additives on the Filtrate Volume and Cake Thickness on Water-based Drilling Fluids
P-CM20
F.K.G. Santos, G.A.S. Nóbrega, J.L.B. Oliveira, D.A.A. Gomes

Effect of glycerol plasticizer on chitosan physical properties and its application to chitosan nanoparticles-based biofilms production.
P-CM21
M.Y. Fukumori, H.K.S. Souza, M.P. Gonçalves

Biotechnological conversion of citrus molasses into poly (3-hydroxybutyrate)
P-CM22
J.L. Ienczak, A.A de Melo, F. Dalcanton, M.L. Fiorese, W. Schmidell, G.M.F. de Aragão

Monitoring the Isolation of Ptaquiloside, a Natural Carcinogen From Bracken (*Pteridium* spp.)
P-CM23
J.P. Caçador, R.M. Gil da Costa, M.M.S.M. Bastos

Characterization of Controlled Release Systems: Encapsulated Orange Oil
P-CM24
J.V. Barbosa , F. Martins, C.F. Silva, J.M. Sousa, F.D. Magalhães, M.M.S.M. Bastos

Selective and Sustainable Oxidation of Cyclohexane Catalyzed by Co-doped SnO_2 Nanoparticles under Mild Conditions
P-CM25
T.F.S. Silva, L.M.D.R.S. Martins, R. Nunes, O.C. Monteiro, A.J. Silvestre, A.J.L. Pombeiro

Electrochemical Magnetoassay for the Detection of Genetically Engineered Soybean
P-CM26
C.L. Manzanares, M.F. Barroso, I. Mafra, J. Costa, N. de-los-Santos-Álvarez, M.J.L. Castañón, B. López-Ruiz, M.B.P.P. Oliveira, C. Delerue-Matos

Gold nanoparticles synthesis using sodium borohydride and sodium citrate: A comparative study
P-CM27
D. Cruz, M.F. Barroso, C. Delerue-Matos, J.R. Santos-Junior, R. Fonseca

Oxidation of VOCs in outdoor air catalysed by cellulose/silica supported molybdovanadophosphates $[PMo_{12-x}V_x]^{(3+x)}$-(x=1,2)
P-CM28
M.C. Loureio, M. Evtyugina, J.A.F. Gamelas, I. Portugal, D.V. Evtuguin

Healing Activity Induced by Glucose/Mannose Lectins in Mice
P-CM29
C.M.L. Melo, V.P. Brustein, A.F.M. Vaz, C.C.B. Cavalcanti, P.M.G. Paiva, J.A. Teixeira, L.C.B.B. Coelho, M.G. Carneiro-da-Cunha, A.M.A. Carneiro-Leão, M.T.S. Correia

Studies of sesquiterpene lactones with potential antitumoral activity: purification, characterization and synthesis of aminoderivatives
P-CM30
M.J.C. Fachada, J.V. Barbosa, R.M. Gil da Costa, D.C.G.A. Pinto, A.M.S. Silva, M.M.S.M. Bastos

Cafestol and Kahweol Content in Espresso Coffees as Influenced by Preparation Parameters
P-CM31
M. Moeenfard, J.A. Silva, N. Borges, A. Santos, A. Alves

Evaluation of Chlorogenic Acids in Coffee Brews Prepared by Recent Technologies
P-CM32
M. Moeenfard, L. Rocha, A. Alves

Effect of Doping On The Photocatalytic Activity of TiO_2 Nanowires Prepared By the Hydrothermal Method
P-CM33
M.O. Honório, R.F.P.M. Moreira, A. Mendes, L. Andrade

Evaluation of the total antioxidant capacity of vegetables by using optical conventional methods and a DNA-based biosensor
P-CM34
S. Costa, M.S.B. Gonçalves, M. Rodrigues, M. Correia, A. Carvalho, M.J. Ramalhosa, M.F. Barroso, C. Delerue-Matos

Assessment of the antioxidant capacity of juices using a DNA-based biosensor: Oxidative damage by radicals (a comparative study)
P-CM35
D. Cruz, M.S.B. Gonçalves, M.F. Barroso

Microencapsulation of Vitamin A by Spray-Drying Process
P-CM36
M. Shahgol, B.N. Estevinho, F. Rocha

Explosive Detection by Calix[4]arene-carbazole-containing Polymers
P-CM37
P.D. Barata, J.V. Prata

Development of a high affinity molecular imprinted polymer for the selective removal of 5-FU from contaminated waters
P-CM39
P.E. Sá, M.S.F. Santos, A. Alves

Carbon Nanotubes As Catalysts For Advanced Oxidation Processes: The Role of O, N and S Surface Groups
P-CM40
R.P.Rocha, J. Restivo, A.M.T. Silva, J.J.M. Órfão, M.F.R. Pereira, J.L. Figueiredo

Development of Stimuli-Responsive Smart Hydrogels using Molecular Imprinting and Interpenetrating Polymer Networks
P-CM41
T. Oliveira, P. Reitor, D. Oliveira, P. Kadhirvel, R.C.S. Dias, M.R.P.F.N. Costa

Organic-inorganic sol-gel coating of paper surfaces for High Pressure Laminates
P-CM42
S.P. Magina, D.V. Evtuguin, I. Portugal, J. Ferra, P. Cruz

Separation and Concentration of Phenylglycine and Ampicillin through Packed-bed Adsorption
P-CM43
M.F. Vieira, S.H.B. Faria. M. De Souza, R.C. Giordano, R.L.C Giordano

Silica-based nanocoating and modified xylan films for enhancement of paperboard barrier properties
P-CM44
V.M. Dias, I. Portugal, A. Kuznetsova, J. Tedim, M. Zheludkevich, D.V. Evtuguin

Synthesis of Organic Derivatives of Kaolinite. Characterization and Protein Adsorption Properties
P-CM45
M.A. Villa-García, R. Duarte-Silva, M. Rendueles, M. Díaz

Catalytic Wet Peroxide Oxidation of Olive Oil Mill Wastewater over Copper Bearing Zeolite Based Catalysts
P-CM46
K.M. Valkaj, I. Polak, S. Islamović, D. Husanović, S. Zrnčević

POSTER SESSION – ENERGY

Optimization of glycerol-organosolv pretreatment for improving enzymatic saccharification of Eucalyptus wood
P-EN1
A. Romaní, H.A. Ruiz, F.B. Pereira, J.A. Teixeira, L. Domingues

Use of whole-slurry from autohydrolyzed *Eucalyptus* wood for bioethanol production
P-EN2
A. Romaní, H.A. Ruiz, F.B. Pereira, J.A. Teixeira, L. Domingues

Biodiesel by Oil Methanolysis Over Sol-Gel Like VPO Catalysts: Bulk Versus Supported Catalysts
P-EN3
C. Domingues, M.J.N. Correia, R. Carvalho, C. Henriques, J. Bordado, A.P.S. Dias

Screening Yeasts Strains for Bioethanol Production Using Goat Cheese Whey as Raw Material
P-EN4
C. Felizardo, B. Rodrigues, A. Constantino, T. Fernandes, D. Monteiro, F. Neves, L. Dionisio, S. Raposo, M.E. Lima-Costa

Reactivation of Microbial Fuel Cell prototypes after a long shut down period
P-EN5
A. Canavarro, V. Mendes, R.J. Barros

A Kinetic Overview of Fermentative Performance of *Saccharomyces cerevisiae* Using Carob Industry Wastes as Carbon Source
P-EN6
B. Rodrigues, A. Constantino, S. Raposo, J.M. Peinado, M.E. Lima-Costa

Nitrogen Limitation on Lipid Accumulation by the Oleaginous Yeast Rhodosporidium toruloides
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S. Raposo, L. Tangerino, M. Val, F. Guerreiro, M.E. Lima-Costa

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Low Density Polyester Particles As Lightfillers For Wood-based Panels

ORAL
(#3)
Journal: **NONE**

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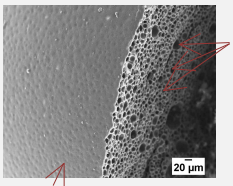

This work studies the synthesis of low density particles (LDPs) based on crosslinked polyester, each particle containing numerous air-filled vesicles. Due to its particular internal structure and rigidity they can be used as fillers in wood-based panels to reduce the final density and keep their desired mechanical performance. Important process variables as stirring conditions, type of cure initiator and drying conditions were studied. Particles well vesiculated and with diameters in the range 1- 4 mm were prepared and its performance in wood-based panels is an on-going study.

Introduction

In the last decades, the furniture industry's demand for light wood-based panels has increased, in particular due to the popularity of "takeaway" furniture. Consumers prefer products that are available at time of purchase and that can be easily handled which justifies lightness as the fundamental requirement. On the other hand, there is a current trend in furniture design that involves high thickness components, and hence a reduction of weight is desirable, for economical (material and transportation costs), environmental reasons (resources, eco-efficiency), and organizational reasons.

Numerous approaches have been made to save weight by using low density wood species [1] or other plant fibers (e.g. hemp [2]), sandwich panels with foam core [3] or honeycomb core [4], or by incorporating polymeric particles during wood-based panels production (e.g. expanded polystyrene [5]). However, the reduced weight comes along with a decline of the mechanical properties (bending strength and internal bond), the porous edges decrease the resistance to axial withdrawl of screws and prejudices the quality of finishing (coating, edge lamination) and machinability. In this study, low density particles (LDPs) made of crosslinked polyester were introduced as light fillers for wood-based panels. These particles combine low density and high mechanical resistance as a result of an internal multi-alveolar structure separated by rigid polymeric walls. Some studies about the production of multivesiculated polyester particles with a mean size of 10 μm are already available in the literature [6] still with the purpose of its application as opacifiers in paints. In the wood-panels case, larger particles (diameters above 1mm) are desired. In this study, the influence of the stirring rate conditions, type of cure initiator and the drying process conditions on final internal vesiculation, particle size and density were studied. The performance of the optimized particles will then be evaluated in wood-based particleboards.

Particles preparation and characterization

For producing LDPs, an organic phase comprising unsaturated polyester dissolved in styrene, is dispersed in an aqueous solution of polyvinyl alcohol (PVA) at high stirring rate. A base is previously added to the organic phase, causing the neutralization of the polyester carboxyl groups and forming polyester salts which leads to the diffusion from the external aqueous medium. This entrapped water forms the internal vesicles, and the whole system becomes a water-in-oil-in-water (W/O/W) emulsion (double emulsion). A radical polymerization is then initiated by adding a water soluble initiator system (cumene hydroperoxide in combination with a metal redox activator).

Final LDPs are then washed with distilled water and dried at 80 ºC for 2 hours.

Final particle size distributions were obtained by sieving (sieves with open mesh of 100 μm, 1 mm and 2 mm, supplied by Retsch). Particle morphology and internal vesiculation were observed by scanning electron microscopy (SEM), using a JEOL JSM-6301F, Oxford INCA Energy

350 equipment. For this purpose, dried particles were encapsulated in epoxy resin, and the resulting composite was fractured after hardening at 90 °C overnight. Before being analyzed, samples were sputtered with gold/platinum using a K575X Sputter Coater by Quorum Technologies. The bulk density of the particles was determined by mercury porosimetry.

Results

During the dispersion phase, the studied stirring rates were: 200 RPM, 600 RPM, 750 RPM, 1000 RPM and 1400 RPM, maintaining the rest of process variables. Figure 1 depicts the internal morphology of the particles and two different trends seem to exist.

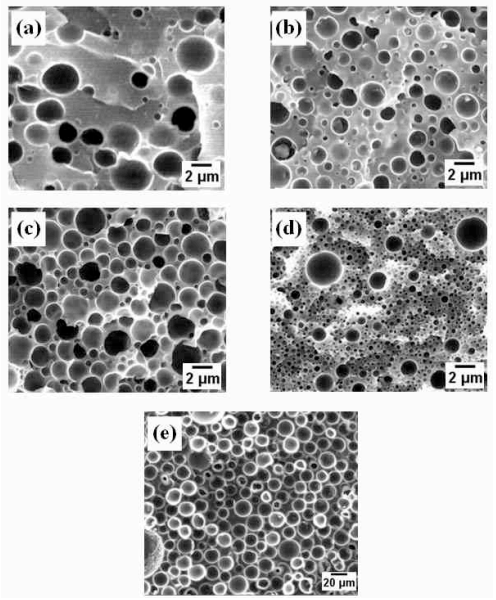

Figure 1. Middle of a fractured polyester particle produced with different dispersion stirring rates: 200 RPM (a), 600 RPM (b), 750 RPM (c), 1000 RPM (d) and 1400 RPM (e).

For the lowest shear rates, the number of vesicles in the middle of the particle increased, maintaining an average size of 2 µm (Figure 1a, 1b and 1c) which means that the higher stirring was favouring the diffusion of external water into the organic droplets. SEM images from a peripheral zone of Figures 1a and 1b evidenced a larger number of vesicles and corroborated that lower stirring rates were not enough to promote water diffusion towards the centre of the droplet. Higher stirring rate caused successive droplet rupture/coalescence, leading to large heterogeneity in final vesicles sizes (Figure 1d). Finally, at 1400 RPM, vesicles were almost uniformly formed with much larger sizes (15 µm), as showed in Figure 1e. The improvement in vesiculation justified the decreasing in measured densities values from 1000 kg/m^3 to 600 kg/m^3.

Due to the influence of dispersion parameters on the final particle sizes, a second step, at lower stirring rate, was implemented in order to allow droplet coalescence and formation of larger particles. Figure 2 shows the particle size distribution of LDPs studied at these conditions.

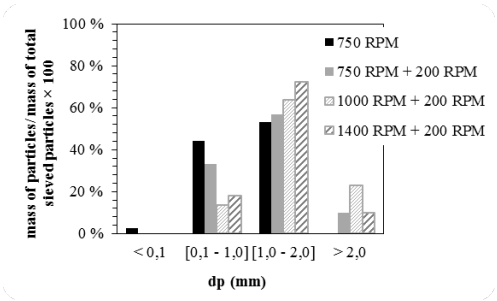

Figure 2. Influence of the implementation of a second lower stirring rate during the dispersion phase on the final particle size distribution.

As predicted, the implementation of a lower second stirring period favoured the coalescence of the organic droplets into bigger one, leading to a displacement of the final distribution to the right and removing particles smaller than 100 µm. Not so predictable was the observed tendency for obtaining larger particles by increasing the first stirring rate. In this regime, higher stirring is increasing droplet coalescence due to more frequent collisions.

Cured particles fractured during the final drying stage at 80 ºC (Figure 3), probably due to internal pressure created by water vapour combined with residual stresses originated during cure. Replacing the water-soluble radical initiator by an organic-soluble one, solved the problem, due to a more uniform curing throughout the entire particle.

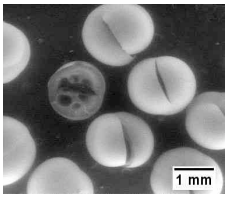

Figure 3. Fractured particles after the drying process at 80 ºC for 2 hours.

Due to the importance in obtaining particles with the lowest density, the final drying process is a critical stage. Particles with the same diameter (4

mm) were first dried at 80 ºC for 2 hours to avoid the internal fracture. One of the series was then kept at this temperature while the other particles were left to dry at 105 ºC till the final mass keep constant. The volume of the particles was indirectly measured by a caliper rule. Figure 4 shows the evolution of the calculated density in relation to the initial value (d/d^o) during the drying process. The density of the polymer (polyester reticulated with styrene) was determined by water pycnometry and it corresponded to 1211 kg/m^3.

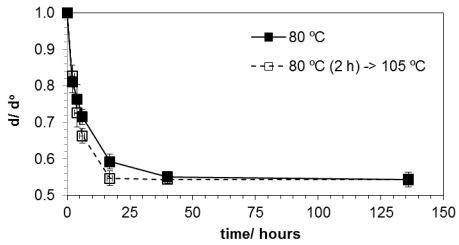

Figure 4. Evolution of the normalized density of particles during the drying process.

As predicted, the drying process can be accelerated by increasing the drying temperature and it was verified that it not compromised the internal structure. According to the results, it might be possible to take off the internal water from the vesicles after 48 hours. The final density of the dried particles corresponded to 600 kg/m^3.

Conclusions

Low density particles (LDPs) made of crosslinked polyester that incorporate numerous air-filled domains and with sizes in the range 1 - 4 mm were synthetized. For its preparation, some process variables are now well understood: higher stirring rates during the dispersion of polyester droplets leads to less dense particles due to better vesiculation. Larger particles can be obtained by implementing a second step at a lower stirring rate. Tendency to fracture during drying was eliminated by using an organic-soluble cure initiator. LDPs must be dried at least 2 days at 80 ºC, to remove as much water as possible and achieve the lowest density.

We are now evaluating the performance of these particles in wood-based panels, namely the intended compromise between panel density, internal bond and bending strength.

Acknowledgements

This work is co-founded by FEDER/QREN (Lightfillers project with reference FCOMP-01-0202-FEDER-30178 in the framework of Programa Operacional Factor de Competitividade.

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