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PERSONAL CENTRE CATALÀ DEL PLÀSTIC

· Directora
Prof. Maria Lluïsa Maspoche Rulduà
Catedràtica d’Universitat (UPC - BarcelonaTech)
Coordinadora de l’àrea de “Recuperació i Reciclatge”

Coordinadors del Pla de Qualitat i del Pla de Medi Ambient
Dr. David Arencón Osuna
Sra. Anna Carreras Amat

· Secretaria i Administració
Sra. Anna Carreras Amat
Sra. Susana Ortiz Alfaro

· Coordinadors d’Àrea
Prof. Antonio Martínez Benasat
Catedràtic d’Universitat (UPC - BarcelonaTech)
Coordinador de l’àrea d’Enginyeria”

Dr. Miguel Sánchez Soto
Professor Titular (UPC - BarcelonaTech)
Coordinador de l’àrea d’Injecció”

Dr. Orlando Santana Pérez
Professor Agregat (UPC - BarcelonaTech)
Coordinador de l’àrea de “Caracterització” i de “Formació”

Prof. José Ignacio Velasco Perero
Catedràtic d’Universitat (UPC - BarcelonaTech)
Coordinador de l’àrea “d’Extrusió i Composició”

· Responsables de Tallers/Laboratoris
Dr. Tobias Abt
Responsable dels “Laboratoris d’assaigs de control de qualitat”, “Laboratori d’assajos mecànics”

Dr. David Arencón Osuna
Professor Agregat (UPC - BarcelonaTech)
Responsable del “Taller d’injecció”
Dr. Marcelo de Sousa Pais Antunes
Professor Agregat (UPC - BarcelonaTech)
Responsable del "Taller d'extrusió"

Dra. Vera Cristina de Redondo Realinho
Professora Lectora dins del programa Serra Hunter (UPC - BarcelonaTech)
Responsable del “Taller d’extrusió” i del “Laboratori de Foc”

Dr. Jonathan Cailloux
Professor Associat (UPC - BarcelonaTech)
Responsable dels “Laboratoris d’assajos tèrmics”
FORMACIÓ

⇒ FORMACIÓ REGLADA

Primer, segon cicle i graus

Universitat Politècnica de Catalunya (UPC) – BarcelonaTech

· Centre: Escola Superior d’Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa (ESEIAAT)

I Titulació: Graus en l’Àmbit d’Enginyeria Industrial (Disseny Industrial i Desenvolupament de Producte, Elèctrica, Electrònica Industrial i Automàtica, Mecànica, Química, Tecnologia i Disseny Tèxtil).

1. Assignatura: Ciència i Tecnologia de Materials.

II Titulació: Grau en Enginyeria de Disseny Industrial i Desenvolupament del Producte.

2. Assignatura: Taller de Disseny d’Objectes de Plàstic.
3. Assignatura: Selecció de Materials per al Disseny Industrial.

III Titulació: Grau en Enginyeria Mecànica.

4. Assignatura: Tecnologia de Materials Plàstics.

IV Titulació: Grau en Enginyeria en Tecnologies Industrials.

5. Assignatura: Ciència de Materials.


5. Assignatura: Ciència de Materials.
· Centre: Escola Tècnica Superior d’Enginyeria Industrial de Barcelona (ETSEIB)

VI Titulació: Grau en Enginyeria en Tecnologies Industrials.

10. Assignatura: Tecnologia i selecció de materials.

· Centre: Escola d’Enginyeria Barcelona Est (EEBE)

VII Titulació: Enginyeria Europea de Materials.

11. Assignatura: Tecnologia de Plàstics.

VIII Titulació: Grau en Enginyeria de Materials.

15. Assignatura: Materials Plàstics i Compòsits.
17. Assignatura: Reciclatge i Matèries Primes.
Màsters oficials

Universitat Politècnica de Catalunya (UPC) - BarcelonaTech

· Centre: Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa (ESEIAAT)

I Programa: Màster en Enginyeria Aeronàutica i Aeroespacial (MUEA)
  - Assignatures:

II Programa: Màster Universitari en Estudis Avançats en Disseny-Barcelona (MBDesign)
  - Assignatures:

· Centre: Escola Tècnica Superior d'Enginyeria Industrial de Barcelona (ETSEIB)

  - Assignatures:
    3. Disseny, Ecodisseny i Reciclatge de Materials.

· Centre: Escola d’Enginyeria de Barcelona Est (EEBE)

IV Programa: Ciència i Enginyeria de Materials.
  - Coordinació acadèmica des de maig de 2011.
  - Assignatures:
    4. Tecnologia de Materials Plàstics.
    5. Control, verificació i Auditories.

V Programa: Erasmus Mundus Master in Advanced Materials Science and Engineering (AMASE).
  - Institucions coparticipants:
    Institut Nationale Polytechnique de Lorraine (França).
    Lulea University of Technology (Suècia).
    Universitat des Saarlandes (Alemanya).
- Assignatures:
  4. Tecnologia de Materials Plàstics.
  5. Control, verificació i Auditories.
  6. Estructura i propietats dels polímers.

VI Programa: Enginyeria Química.
- Assignatures:
  10. Tecnologia de Polímers II.

- Centre: Escola Superior d’Agricultura de Barcelona (ESAB)

VII Programa: 
\textit{Tecnologies Facilitades per a la Indústria Alimentària i de Bioprocessos (KET4 FOOD + BIO)}.
- Assignatures:
  11. 
  \textit{Innovacions tècniques en processos agroalimentaris i biotecnològics}.

- Doctorat:
  Coordinació del programa de doctorat “Ciència i Enginyeria dels Materials”.

- PostGrau:
  - 
    
    \textit{Postgrau CAE en Enginyeria Assistida per ordinador}.
  - 
    \textit{Simulació de Plàstics}.
  - 
    \textit{Postgrau polímers. Màster EMEI Enginyeria Mecànica i Equipament Industrial}.
Formació d'investigadors

- Treballs Finals de Grau

1. Títol: Reaprofitament de taps de plàstics per a la fabricació de provetes per a les pràctiques docents.
   Autor: Albert Cejudo Lapuyade.
   Titulació: Enginyeria de Materials.
   Director: M. Ll. Maspoch.
   Data: Juny de 2018.

2. Títol: Estudio de la caracterización de películas poliméricas altamente orientadas.
   Autor: Laia Fontelles Batalla.
   Titulació: Grau en Enginyeria de Vehicles Aeroespacials.
   Director: Dr. D. Arençon.
   Data: Juny de 2018.

   Autor: Arnau Planas Carbonell.
   Titulació: Enginyeria Tecnologies Industrials.
   Director: Dr. M. Antunes.
   Data: En curs.

- Treballs de màster finalitzats

1. Títol: Microfibrilación in situ de mezclas biobasadas de PLA\textsubscript{REX}-PA 10.10 mediante estiramiento en caliente durante el proceso de extrusión.
   Autor: Arnau Vidal.
   Universitat: UPC - BarcelonaTech
   Titulació: Enginyeria de Materials
   Director: J. Cailloux.
   Data: 22 de febrer de 2018.

2. Títol: Microinyección de polilefinas cíclicas con calidad óptica para su uso en dispositivos electrónicos.
   Autor: Jhoan Emeterio Espinoza.
   Universitat: Tecnológico de Monterrey.
   Titulació: Licenciat en Ciències Químiques.
   Director: Prof. M. Ll. Maspoch.
   Data: Juliol 2018.
3. Títol: Mejora de la calidad de piezas de plástico por la integración de tecnologías innovadoras en el proceso de inyección.
   Autor: Mario Mantilla.
   Universitat: UPC - BarcelonaTech.
   Titulació: Enginyeria Aeronàutica.
   Director: Dr. M. Sánchez.
   Data: Juliol 2018.

4. Títol: PLA/PA microfibriliated bioblends for 3D printing.
   Autor: Sergi Bafaluy.
   Universitat: EEIGM.
   Titulació: Enginyeria de Materials.
   Director: Dr. O. Santana i Dr. J. Cailloux.

5. Títol: Revalorización del PET opaco reciclado en materiales innovadores.
   Autor: Núria Talavera.
   Universitat: EEIGM.
   Titulació: Enginyeria de Materials.
   Director: Dr. O. Santana i Dr. J. Cailloux.
### Tesis doctorals finalitzades

1. **Títol:** ON THE FRACTURE BEHAVIOUR OF DUCTILE POLYMER FILMS: NOTCH QUALITY ESSENTIAL WORK OF FRACTURE, J-INTEGRAL, AND CRACK TIP OPENS DISPLACEMENT.
   - **Doctorant:** N. León.
   - **Director:** Prof. A. Martínez.
   - **Centre d'origen:** Universidad Autónoma del Estado de México (Mèxic).
   - **Data:** 13 d'abril de 2018.
   - **Qualificació:** Excel·lent Cum Laude.

2. **Títol:** PREPARATION AND CHARACTERIZATION OF NANO COMPOSITES BASED ON POLYLACTID THERMAL, RHEOLOGICAL, MECHANICAL AND FRACTURE PROPERTIES.
   - **Doctorant:** H. Rajanazrul.
   - **Director:** Prof. M. Ll. Maspoch i Dr. O. Santana.
   - **Centre d'origen:** Universiti Sains Malaysia (Malàisia).
   - **Data:** 01 de juny de 2018.
   - **Qualificació:** Cum Laude.

### Tesis doctorals en curs

1. **Títol:** DEVELOPMENT OF MULTIFUNCTIONAL FOAMS BASED ON THERMOPLASTIC POLYETHERIMIDES AND GRAPHENE NANOPLATELETS FOR ADVANCED APPLICATIONS.
   - **Doctorant:** H. Abbasi.
   - **Director:** Prof. J. I. Velasco i Dr. M. Antunes.
   - **Centre d'origen:** UPC - BarcelonaTech.
   - **Data:** En curs.

2. **Títol:** MEMBRANAS POLIMÈRICAS MICROPOROSAS.
   - **Doctorant:** P. Castejón.
   - **Director:** Dr. D. Arencón.
   - **Centre d'origen:** UPC - BarcelonaTech.
   - **Data:** En curs.

3. **Títol:** STUDY OF THE PROPERTIES OF PLA-ABS and PLA-PA BLEND S.
   - **Doctorant:** M. Reza.
   - **Director:** Dr. M. Sánchez.
   - **Centre d'origen:** Islamic Azad University of Shiraz (Irán).
   - **Data:** En curs.
4. Títol: DEVELOPMENT AND CHARACTERIZATION OF MINERAL FILLED (CALCIUM CARBONATE OR TALC) POLYPROPYLENE POROUS MEMBRANES OBTAINED BY EXTRUSION.
Director: Dr. D. Arencón.
Doctorant: K. Habibi.
Centre d'origen: University of Tehran (Irán)
Data: En curs.

5. Títol: MEJORA DE LA PERCEPCIÓN DE LA CALIDAD SUPERFICIAL DE LAS PIEZAS INYECTADAS DEL INTERIOR DEL VEHÍCULO.
Doctorant: P. Gamonal.
Director: Prof. M. Ll. Maspoch.
Centre d'origen: UPC
Data: En curs.

6. Títol: ADECUACIÓN MORFOLÓGICA ADIDE MEZCLAS PLA/PA PARA IMPRESIÓN ADITIVA POR DEPOSICIÓN.
Doctorant: V. Del Valle García.
Director: Prof. M. Ll. Maspoch i O. Santana.
Centre d'origen: Universidad Simón Bolívar.
Data: En curs.

7. Títol: REVALORIZACIÓN Y COMPORTAMIENTO A FRAC TURA DE NUEVAS FORMULACIONES EN BASE PET/TiO2 POST-CONSUMO.
Doctorant: Alfonso David Loaeza.
Director: Prof. M. Ll. Maspoch i O. Santana
Centre d'origen: Universidad Nacional Autónoma de México (UNAM)
Data: En curs.

8. Títol: Per definir.
Doctorant: Farnaz Ghonjizadeh
Director: Dra. V. Realinho
Centre d'origen: Amirkabir University of Technology (Tehran Polytechnic)
Data: En curs.
9. **Título:** FORMULACIONES IGNÍFUGAS PARA CUBIERTAS DE CABLES ELÉCTRICOS.

**Doctorant:** Jhoan Sebastián Rodríguez.

**Director:** Dra. V. Realinho

**Centro de origen:** Universitat Politècnica de Catalunya.

**Fecha:** En curs.
Visites d’estudiants UPC - BarcelonaTech

1. **Centre:** ETSEIB  
   **Data:** 23 d’abril de 2018.  
   **Nº assistents:** 5

2. **Centre:** Universitat de Barcelona (UB)  
   **Data:** 16 de maig de 2018.  
   **Nº assistents:** 7

**Resum de visites**

2 visites durant el períoide Gener 2018 – Desembre 2018, amb un total de 12 assistents.
FORMACIÓ NO REGLADA

Formació per a empreses

1. Títol: 21è Cicle d’Especialització en Plàstics.
   Organitzador: CCP.
   Lloc: CCP.

2. Títol: Curs personalitzat del mòdul “Tecnologia de Materiales Plàstics” a l’empresa Silgan Dispensing Barcelona, S.L.
   Organitzador: CCP.
   Lloc: Empresa Silgan Dispensing Barcelona S.L (Barcelona).
   Data: 12, 14, 19 i 21 de juny de 2018.

3. Títol: Curs de formació de residus plàstics personalitzat al Gremi de Recuperació de Catalunya.
   Organitzador: CCP.
   Lloc: CCP.
   Data: 14 de juny de 2018.

4. Títol: Curs pràctic - teòric de plàstics, assajos mecànics e injecció personalitzat a l’empresa SEAT, S.A
   Organitzador: SEAT, S.A i el CCP.
   Lloc: CCP.
   Data: 25 de juliol de 2018.
   05 de setembre de 2018.

Formació a universitats

1. Títol: Curs de Tecnologías en Polímeros y Compuestos.
   Organitzador: CENTA (Centro Nacional de Tecnologías Aeronáuticas) i CCP.
   Lloc: Querétaro - Mèxic.
   Data: 08 de novembre de 2018.

Estades acadèmiques

   Organitzador: Uho - Universidad de Holguín.
   Lloc: Dep. de Química. Universidad de Holguín (Cuba).
   Data: del 02 al 05 de febrer de 2018.
1. Títol: Pla d'acollida  
   Organitzador: CCP  
   Personal: Tot el personal de nova incorporació  
   Data: Gener de 2018 - Desembre de 2018

2. Títol: Qualitat  
   Organitzador: CCP  
   Personal: Tot el personal del CCP  
   Data: Gener de 2018 - Desembre de 2018

3. Títol: Gestió ambiental  
   Organitzador: CCP  
   Personal: Tot el personal del CCP  
   Data: Gener de 2018 - Desembre de 2018

4. Títol: Utilització d'equips  
   Organitzador: CCP  
   Personal: Tot el personal de nova incorporació  
   Data: Gener de 2018 - Desembre de 2018
**Col·laboracions en el marc docent i investigador**

Intercanvi recíproc en activitats acadèmiques i d'investigació que es celebren en el Cos Acadèmic d’Innovació Tecnològica per al Disseny (UDG-CA-381) del Centre Universitari d’Art, Arquitectura i Disseny de la Universitat de Guadalajara (Mèxic) i el Centre Català del plàstic.

**Pertinença a xarxes d'investigació**

- Pertinença a la “Red Española de Fractura de Entallas” (Red REFE).
- Pertinença a Redes de Excelencia (MINECO).
- Biopolímeros y materiales compuestos sostenibles (Red Biopol)
**R+D+i**

- **Projectes competitius**
  - Aplicaciones industriales de compuestos y mezclas basados en REX - PLA. MAT2016-80045-R.
  - Packaging and coatings from renewable sources: TECSPR16-1-0071.
  - Espumas poliméricas multifuncionales basadas en termoplasticos de alta temperature. MAT2017-89787-P

- **Altres ajudes competitves**
  - Redes de excelencia: Biopolímeros y materiales compuestos sostenibles. MAT2014-55778-REDT.

- **Projectes per a empreses**
  
  - **Projectes per a empreses realitzats o en curs: Import superior a 9.000€**
    1. Impresión 3D aditiva (PLA Premium-projecte NUCLIS).
    2. Fabricación utillaje de sujeción de componentes para la inyección.
    3. Estudio preliminar de materiales y formulaciones, su extrusión y análisis de cara su uso como materiales para la fabricación de tubos de plásticos.
    4. Trabajos investigación proyecto DIPC.
  
  - **Serveis empreses realitzats o en curs: Import inferior a 9.000€**
    93 Serveis realitzats.

- **Recepcions de clients:** 182 consultes
Publicacions

- **Revistes indexades** (*indexades al Science citation index*)

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<tr>
<td>MECHANICAL AND BARRIER PROPERTIES ENHANCEMENT IN FILM EXTRUDED BIO-POLYAMIDES WITH MODIFIED NANOCLAY</td>
<td>D. Battegazzore, Angela Sattin, M. Ll. Maspoch, A. Frache</td>
<td>Polymers Composites (2018) 1-12</td>
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1. Títol: **EPOXY COULING AGENT FOR PLA AND PHB COPOLYMER-BASED COTTON FABRIC BIO-COMPOSITES.**
   
   **Autors:** D. Battegazzore, Alberto Frache, T. Abt, M. Ll. Maspoch.
   
   **Referència:** Composites Part B 148 (2018) 188-197.
   
   **Factor d’impacte:** 4,727 (Q1 - Materials Science, Composites & Engineering Manufacturing)
   

2. Títol: **MICROCELLULAR PP / GF COMPOSITES: MORPHOLOGICAL, MECHANICAL AND FRACTURE CHARACTERIZATION.**
   
   **Autors:** J. Gómez - Monterde, M. Sánchez - Soto, M. Ll. Maspoch.
   
   
   **Factor d’impacte:** 4,075 (Q1 - Materials Science, Composites & Engineering Manufacturing)
   
   doi.org/10.1016/j.compositesa.2017.10.014.

3. Títol: **POLYPROPYLENE – BASED POROUS MEMBRANES: INFLUENCE OF POLYMER COMPOSITION, EXTRUSION DRAW RATIO AND UNIAXIAL STRAIN.**
   
   **Autors:** P. Castejón, K. Habibi, Amir Saffar, Abdellah Ajj, A. B. Martínez, D. Arencón.
   
   
   **Factor d’impacte:** 3,364 (Q1- Polymer Science)
   
   doi.10.3390/polym10010033.

4. Títol: **EFFECTS OF CARBON NANOTUBES/GRAPHENE NANOPLATELETS HYBRID SYSTEMS ON THE STRUCTURE AND PROPERTIES OF POLYETHERIMIDE-BASED FOAMS.**
   
   **Autors:** H. Abbasi, M. Antunes, J. I. Velasco.
   
   
   **Factor d’impacte:** 3,364 (Q1- Polymer Science)
   
   doi.10.3390/polym10040348.
5. Títol: FLAME RETANDANCY EFFECT OF COMBINED AMMONIUM POLYPHOSPHATE AND ALUMINIUM DIETHYL PHOSPHINATE IN ACRYLONITRILE-BUTADIENE-STYRENE.

Authors: V. Realinho, Laia Haurie, Joan Formosa, J. I. Velasco.
Factor d’impacte: 3,193 (Q1 - Polymer Science)
doi.org/10.1016/j.polymdegradstab.2018.07.022

6. Títol: THE EFFECT OF FATTY ACIDS ON THE PHYSICOCHEMICAL PROPERTIES OF EDIBLE FILMS COMPOSED OF GELATIN AND GLUTEN PROTEINS.

Referència: LWT - Food Science and Technology 87 (2018) 293-300.
Factor d’impacte: 3.129
dx.doi.org/10.1016/j.lwt.2017.08.056.

7. Títol: EFFECT OF THE VISCOSITY RATIO ON THE PLA/PA10.10 BIOBLENDS MORPHOLOGY AND MECHANICAL PROPERTIES.

Factor d’impacte: 2,983 (Q1- Polymer Science)
doi.org/10.3144/expresspolymlett.2018.47

8. Títol: POROUS MEMBRANES BASED ON POLYPROPYLENE-ETHYLENE COPOLYMERS. INFLUENCE OF TEMPERATURE ON EXTRUSION, ANNELAING AND UNIAXIAL STRAIN STAGES.

Authors: P. Castejón, D. Arencón, M. Antunes, V. Realinho, J. I. Velasco, A. B. Martínez.
Factor d’impacte: 2,935 (Q1- Polymer Science).
9. Títol: HIGHLY FLAME RETARDANT MELAMINE-FORMALDEHYDE CROSS-LINKED CELLULOSE NANOFRIBRILS/SODIUM MONTMORILLONITE AEROGELS WITH IMPROVED MECHANICAL PROPERTIES.


Factor d’impacte: 2,690 (Q2)

doi: 10.1002/mame.201800379

10. Títol: NOTCH EFFECT ON THE FRACTURE OF A POLYMERIC FILM.


Factor d’impacte: 2,659 (Q1 - Engineering Mechanical)

(Q1 - Mechanics)

doi.org/10.106/j.tafmec.2018.03.011

11. Títol: POLY (AMIDE-IMIDE) AEROGEL MATERIALS PRODUCED VIA AND ICE TEMPLATING PROCESS.


Referència: Materials (2018) 11 , 233

Factor d’impacte: 2,654 (Q2 - “Open Acces”) 

doi.10.3390/ma11020233

12. Títol: POLY(LACTIC ACID) AND ACRYLONITRILE-BUTADIENE-STYRENE BLENDS. INFLUENCE OF ADDING ABS-g-MAH COMPATIBILIZER ON THE KINETICS OF THE THERMAL DEGRADATION.


Factor d’impacte: 2,464 (Q1- Materials Science, Characterization and Testing).

doi.org/10.1016/j.polymertesting.2018.03.010.
13. Títol: MULTIVARIABLE METHODS APPLIED TO FTIR: A POWERFUL TECHNIQUE TO HIGHLIGHT ARCHITECTURAL CHANGES IN POLY (LACTIC ACID).


Referència: Polymer Testing 65 (2018) 264-269

Factor d’impacte: 2,464 (Q1 - Materials Science, Characterization and Testing).


14. Títol: MECHANICAL AND BARRIER PROPERTIES ENHANCEMENT IN FILM EXTRUDED BIO-POLYMERS WITH MODIFIED NANOCLAY.


Referència: Polymer Composites (2018) 1-12

Factor d’impacte: 1,943 (Q2 - Material Science, Composites)

(Q2 - Polymer Science)

doi.10.1002/pc.25056

15. Títol: ENHANCING THE ELECTRICAL CONDUCTIVITY OF POLYETHERIMIDE-BASED FOAMS BY SIMULTANEOUSLY INCREASING THE POROSITY AND GRAPHENE NANOPlatelets DISPERSION.


Referència: Polymer Composites (2018) 1-10

Factor d’impacte: 1,943 (Q2 - Material Science, Composites)

(Q2 - Polymer Science)

doi.10.1002/pc.25029

16. Títol: INFLUENCE OF INJECTION MOLDING PARAMETERS ON THE MORPHOLOGY MECHANICAL AND SURFACE PROPERTIES OF ABS FOAMS.


Factor d’impacte: 1,291 (Q3 - Polymer Science & Engineering Chemical)

doi.10.1002/adv.21944
- **Capítols de llibre**

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<th>TÍTOL</th>
<th>AUTORS</th>
<th>REFERÈNCIA</th>
<th>ISBN</th>
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1. **Titol:** THERMAL, ELECTRICAL, INSULATION AND FIRE RESISTANCE PROPERTIES OF POLYSACCHARIDE AND PROTEIN-BASED AEROGELS.  

   **Autor:** M. Sánchez - Soto, Liang Wang, T. Abt, Lucía G. De la Cruz, D. A. Schiraldi.  

   **Referència:** Green Chemistry Series No. 58. Chapter 10.
- Revistes no indexades

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<th>TÍTOL</th>
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1. Títol: APPLICATION OF THE MINIATURE SMALL PUNCH TEST FOR THE MECHANICAL CHARACTERIZATION OF UV-AGED rPET.

   **Autors:** T. Abt, G. Álvarez, C. Rodríguez, M. Ll. Maspoch.

   **Referència:** Anales de Mecánica de la Fractura 35 (2018) 153-158
   ISSN: 0213-3725
2. Título: **FRACTURA DE LÁMINAS EXTRUIDAS A PARTIR DE PET OPCAO RECICLADO.**


**Referència:** Anales de Mecánica de la Fractura 35 (2018) 195-200
ISSN: 0213-3725


**Autores:** Mingze Sun, Hua Sun, Yutao Wang, M. Sánchez - Soto, D. Schiraldi.

**Referència:** Gels 2018 (2018) 4,33

4. Título: **ALIGERAMIENTO DE PESO DE PP / GF: MATERIALES COMPUESTOS ESPUMADOS PARA APLICACIONES DE AUTOMOCIÓN.**


**Referència:** Revista de la Asociación Española de Materiales Compuestos - AEMAC. Vol 2 nº 2, 40-45 (2018)
ISSN: 2531-0739

5. Título: **MULTI-SCALE SURFACE ANALYSIS ON POLYPROPYLENE MICRO-TEXTURED INJECTED SAMPLES USING 3D NON-CONTACT TECHNIQUES.**

**Autores:** P. Gamonal-Repiso, M. Sánchez - Soto, S. Santos-Pinto, M. Ll. Maspoch.

**Referència:** XV Reunión del Grupo Especializado de Polímeros (RSEQ y RSEF) 231-232 (2018)
ISSN: 978-84-16621-78-1
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<td><strong>IMMC 2018</strong>: 19th International Metallurgy and Materials Congress</td>
<td>Istanbul (Turquia) del 25 al 27 d’octubre de 2018</td>
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<td><a href="#">IMMC 2018</a></td>
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1. **Congrés:** ISNAPOL 2018: 8\(^{\text{th}}\) International Symposium on Natural Polymers and Composites.

**Títol:** **INFLUENCE OF FIBER ADDITION ON THE SOLUBILITY AND WATER VAPOR PERMEABILITY OF FLEXIBLE FILMS BASED ON ARROWWOOT OBTAINED BY THERMOPLASTIC EXTRUSION.**

**Autors:** A. D. Pereira, J. I. Velasco, M. Antunes, L. H. I. Mei, F. M. Fakhouri.

**Lloc:** Sao Pedro City (Brasil)

**Data:** del 27 al 30 de maig de 2018.

**Participació:** Oral.

**Àmbit:** Internacional.


2. **Congrés:** ISNAPOL 2018: 8\(^{\text{th}}\) International Symposium on Natural Polymers and Composites.

**Títol:** **ANALYSIS BY GAS CHROMATOGRAPHY OF EDIBLE FILMS BASED ON GELATIN AND Melaleuca Alternifolia ESEENTIAL OIL.**


**Lloc:** Sao Pedro City (Brasil)

**Data:** del 27 al 30 de maig de 2018.

**Participació:** Oral.


3. **Congrés:** ESTAC12: 12\(^{\text{th}}\) European Symposium on Thermal Analysis and Calorimetry.

**Títol:** **KINETICS OF THE THERMAL DEGRADATION OF PLA/ABS BLENDS. EFFECT OF ADDING ABS-g-MAH COMPATIBILIZER.**


**Lloc:** Brasov - Romania.

**Data:** del 27 al 30 d’agost de 2018.

**Participació:** Pòster.

**Àmbit:** Internacional.
4. **Congrés:** ICSS21: 21st International Conference on Composite Structures  
**Títol:** STRUCTURE AND PHYSICAL PROPERTIES OF POLYETHERIMIDE FOAMS CONTAINING LOW AMOUNTS OF GRAPHENE NANOPlatelets PREPARED BY SUPERCRITICAL CO₂ DISSOLUTION.  
**Autors:** H. Abbasi, M. Antunes, J. I. Velasco.  
**Lloc:** Bologna (Itàlia).  
**Data:** del 04 al 07 de setembre de 2018.  
**Participació:** Oral.  
**Àmbit:** Internacional.

5. **Congrés:** ICSS21: 21st International Conference on Composite Structures.  
**Títol:** POLYMER / CLAY COMPOSITE AEROGELS.  
**Autors:** D. Schiraldi, M. Sánchez - Soto, Hong – Bing Chen.  
**Lloc:** Bologna (Itàlia).  
**Data:** del 04 al 07 de setembre de 2018.  
**Participació:** Oral.  
**Àmbit:** Internacional.

6. **Congrés:** CMPSE2018: 2nd International Conference on Composite Material, Polymer Science and Engineering.  
**Títol:** KINETICS OF THE THERMAL DEGRADATION OF PLA/ABS BLENDS. EFFECT OF ADDING ABS-g-MAH COMPATIBILIZER.  
**Lloc:** Osaka (Japó).  
**Data:** del 21 al 22 de setembre de 2018.  
**Participació:** Pòster.  
**Àmbit:** Internacional.

7. **Congrés:** IMMC 2018: 19th International Metallurgy and Materials Congress.  
**Títol:** PREPARATION OF NANOCOMPOSITE FOAMS BASED POLYSULFONE AND CARBON-BASED NANOPARTICLES USING WVIPS.  
**Autors:** M. Kerem, H. Abbasi, M. Antunes, S, Aydin, J. I. Velasco.  
**Lloc:** Istanbul (Turquia)  
**Data:** del 25 al 27 d’octubre de 2018.  
**Participació:** Pòster.  
**Àmbit:** Internacional.
8. **Congrés:** IMMC 2018: 19\textsuperscript{th} International Metallurgy and Materials Congress.

**Títol:** EFFECT OF AN IONOMER ON THE MECHANICAL PERFORMANCE OF FLAME RETARDANT ABS FORMULATIONS.

**Autors:** Z. Yurdakul, V. Realinho, M. Antunes, S, Aydin, J. I. Velasco.

**Lloc:** Istanbul (Turquia)

**Data:** del 25 al 27 d'octubre de 2018.

**Participació:** Pòster.

**Àmbit:** Internacional.
### Participació en congressos: NACIONALS

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<th>Event</th>
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<td>Barcelona, 21-23 de març de 2018</td>
</tr>
<tr>
<td>GEP: Grupo Especializado de Polímeros (RSEQ y RSEF)</td>
<td>Punta Umbría (Huelva), 24-27 de setembre de 2018</td>
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<tr>
<td>IDS’2018: 21st International Drying Symposium</td>
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</table>

1. **Congrés:** XXXV Encuentro del Grupo Español de Fractura  
   **Títol:** APPLICATION OF THE MINIATURE SMALL PUNCH TEST FOR THE MECHANICAL CHARACTERIZATION OF UV-AGED Rpet.  
   **Lloc:** Málaga.  
   **Data:** del 14 al 16 de març de 2018.  
   **Participació:** Comunicació oral.  
   **Àmbit:** Nacional.
2. **Congrés:** XXXV Encuentro del Grupo Español de Fractura  
**Títol:** FRACTURAS DE LÁMINAS EXTRUIDAS A PARTIR DE PET OPACO RECICLADO.  
**Lloc:** Málaga.  
**Data:** del 14 al 16 de març de 2018.  
**Participació:** Comunicació oral.  
**Àmbit:** Nacional.

3. **Congrés:** POLYMERS 2018: Design, Function and Application.  
**Títol:** POROUS MEMBRANES BASED ON POLYPROPYLENE-ETHYLENE COPOLYMERS. INFLUENCE OF TEMPERATURE ON EXTRUSION, ANNEALING AND UNIAXIAL STRAIN STAGES.  
**Autor:** P. Castejón, D. Arencón, M. Antunes, V. Realinho, J. I. Velasco, A. B. Martínez.  
**Lloc:** Universitat de Barcelona (*Facultat de Biologia*)  
**Data:** del 21 al 23 de març de 2018.  
**Participació:** Pòster.  
**Àmbit:** Nacional.

4. **Congrés:** POLYMERS 2018: Design, Function and Application.  
**Títol:** ABS-BASED FLAME RETARDANT MICROCELLULAR FOAMS FOR AUTOMOBILE APPLICATIONS.  
**Lloc:** Universitat de Barcelona (*Facultat de Biologia*)  
**Data:** del 21 al 23 de març de 2018.  
**Participació:** Pòster.  
**Àmbit:** Nacional.

5. **Congrés:** GEP: Grupo Especializado de Polímeros (*RSEQ y RSEF*)  
**Títol:** MULTI-SCALE SURFACE ANALYSIS ON POLYPROPYLENE MICRO-TEXTURED INJECTED SAMPLES USING 3D NON-CONTACT TECHNIQUES.  
**Autor:** P. Gamonal-Repiso, M. Sánchez - Soto, S. Santos-Pinto, M. Ll. Maspoch.  
**Lloc:** Punta Umbría (Huelva).  
**Data:** del 24 al 27 de setembre de 2018.  
**Participació:** Oral.  
**Àmbit:** Nacional.
6. **Congrés:** GEP: Grup Especializado de Polímers (RSEQ y RSEF)
**Títol:** TAILORING PLA/PA BIOBLENDS FOR 3D PRINTING APPLICATIONS VIA THE MANUFACTURING OF IN SITU MICROFIBRILLAR COMPOSITE FILAMENTS
**Lloc:** Punta Umbría (Huelva)
**Data:** del 24 al 27 de setembre de 2018.
**Participació:** Oral.
**Àmbit:** Nacional.

7. **Congrés:** GEP: Grup Especializado de Polímers (RSEQ y RSEF)
**Títol:** KINETICS OF THE THERMAL DEGRADATION OF PLA AND ABS BLENDS.
**Lloc:** Punta Umbría (Huelva)
**Data:** del 24 al 27 de setembre de 2018.
**Participació:** Oral.
**Àmbit:** Nacional.

8. **Congrés:** IDS’2018: 21st International Drying Symposium
**Títol:** ASSESSMENT OF THE CONDITIONS OF THE THERMOPLASTIC EXTRUSION PROCESS IN THE BIOACTIVE AND MECHANICAL PROPERTIES OF FLEXIBLE FILMS BASED ON STARCH AND BRAZILIAN PEPPER.
**Lloc:** València (València).
**Data:** del 11 al 14 de setembre de 2018.
**Participació:** Oral.
**Àmbit:** Nacional.
Participació en jornades, conferències

1. Títol de la jornada: INNOVATION WORKSHOP BILBAO
   Lloc: Gaiker - IK4 (Bilbao).
   Data: 30 de gener de 2018.
   Organitzador: Centro Español del Plástico (CEP).
   Participació: Presentació oral com a centre associat al CEP.

2. Títol de la jornada: INNOVATION WORKSHOP VALENCIA
   Lloc: ITENE: Parque Tecnológico - C/ Albert Einstein, 1
         Paterna (València).
   Data: 15 de febrer de 2018.
   Organitzador: Centro Español del Plástico (CEP).
   Participació: Presentació oral com a centre associat al CEP.

3. Títol de la jornada: INNOVATION WORKSHOP ZARAGOZA
   Lloc: ITAINNOVA: Institut Tecnològic d’Aragó.
         (Saragossa)
   Data: 01 de març de 2018.
   Organitzador: Centro Español del Plástico (CEP).
   Participació: Presentació oral com a centre associat al CEP.

4. Títol de la jornada: II JORNADA EMPRESA - ACADEMIA de AEMAC
   Lloc: Madrid.
   Data: 25 de setembre de 2018.
   Organitzador: AEMAC - Asociación Española de Materiales
                 Compuestos.
   Participació: Presentació oral.

Participació en seminaris:

1. Títol del seminari: Seminarios Internacionales de Fronteras de la Ciencia de
   Materiales: Alternativas a los residuos plásticos.
   Lloc: Universidad Politécnica de Madrid - Dept. Ciencia de
         Materiales ETSI Caminos Canales y Puertos (Madrid)
   Data: 09 de maig de 2018.
   Organitzador: Universidad Politécnica de Madrid.
   Participació: Presencial.
Participació en Webinar:

1. Títol del Webinar: Composites de matrizes polímericas espumados.
   Participant: Dr. M. Sánchez - Soto.
   Data: 31 de maig de 2018.
   Organitzador: AEMAC - Asociación de Materiales Compuestos.
   Participació: Online.
**Membres de comitès científics**
M. Ll. Maspoch, membre de:

- Congreso Nacional de Materiales (IBEROMAT)
- 16th European Conference on Composite Materials (ECCM16)

**Membres de comitès editorial de revistes**
J. I. Velasco, membre de:

- ISRN Polymer Science
  [http://isrn.com/journals/ps/](http://isrn.com/journals/ps/)
- International Journal of Composite Materials
  [http://journal.sapub.org/cmaterials](http://journal.sapub.org/cmaterials)
- Journal of Research Updates in Polymer Science

**Àrbitres de revistes**

- ACS Applied Materials & Interfaces
- Afinidad
- Engineering Fracture Mechanics
- European Polymer Journal
- Experimental Mechanics
- Express Polymer Letters
- Información Tecnológica
- Journal of Adhesion Science and Technology
- Journal of Applied Polymer Science
- Journal of Cellular Plastics
- Journal of Composite Materials
- Journal of Materials Science
- Journal of Polymer Science Part B: Polymer Physics
- Journal of Reinforced Plastics and Composites
- Industrial & Engineering Chemistry Research
- International Journal of Heat and Mass Transfer
- Macromolecular Materials and Engineering
- Materials & Design
- Materials Chemistry and Physics
- Materials Letters
- Particuology
- Polymer
- Polymer and Polymer Composites
- Polymer Bulletin
• Polymer Engineering
• Polymer Engineering and Science
• Polymer International
• Polymers for Advanced Technologies
• Revista de la Facultad de Ingeniería de la Universidad Central de Venezuela
• Revista Dyna
• Revista Latinoamericana de Metalurgia y Materiales
• Scientific Research and Essays
• Surface and Coatings Technology

**Avaluadors**

- Agència per a la Qualitat del Sistema Universitari de Catalunya (AQU)
- Agencia de Acreditación en Investigación, Desarrollo e Innovación Tecnológica (AIDIT)
- Agencia Nacional de Evaluación y Prospectiva (ANEP)
- Ministerio de Educación y Ciencia (MEC)
- Agencia EQA Certificados I+D+I

**Participació en associacions científiques**

- European Structural Integrity Society (ESIS)
- Real Sociedad Española de Química
- Real Sociedad Española de Física
- Clúster Agroalimentari de la UPC
- Society of Plastics Engineers
- Xarxa de Tecnologies Avançades de la Producció (XaRTAP)
- Grupo Español de Fractura, Sociedad de Integridad Estructural (GEF)
- Asociación Española de Materiales Compuestos (AEMAC)
- Grup Connect-EU (Materials) Subgrup Automoció
- Tecnio

**Acreditacions de qualitat**

INGECAL, certifica que el Centre Català del Plàstic ha implantat un Sistema de Gestió de la Qualitat segons els requisits del procés d'acreditació del segell TECNIO basat en els requisits de la norma ISO 9001 i el model EFQM.

- **Data certificat:** 25 d'octubre de 2016.
- **Data caducitat certificat:** 25 d'octubre de 2018.
INTERNACIONALITZACIÓ

Estàncies de caràcter científic en el CCP

· Paul Jokinen  
  Case Western Reserve University (USA)  
  de maig de 2018 a juliol de 2018

· Márían Pérez Pérez  
  Universidad de Holguín (Cuba)  
  juny de 2018

Estades científiques al CCP

Timothy Edwars  
Vice-rector academic affairs.  
National University of Science and Technology (MISIS)  
Moscow - Rússia.  
el 14 de febrer de 2018.

Prof. Santiago Forcada  
Subdirector de Asuntos Internacionales de la ESEIAAT.  
el 14 de febrer de 2018.

Prof. i Directora Mirna Lucia Gigante  
Facultad de Enginyeria dels Aliments de la UNICAMP de Brasil.  
el 06 de setembre de 2018.

Convenis amb entitats internacionals

- CIPA (Centro de Investigación de Polímeros Avanzados), de Xile.
Esdevèniments
· Universitat d'Holguín (Cuba)


Es va dur a terme la impartició del curs de Postgrau:

“Procesos de Transformación y Técnicas de Caracterización de Materiales Plásticos”.

Els temes tractats per part de la Prof. M. Ll. Maspoch van ser:

La industria de los plásticos en el mundo, España y Cataluña. El Centro Catalán del Plástico: misión y principales actividades académicas y científicas. Definición de polímero, plástico, macromolécula, pesos moleculares, enlace covalente, síntesis y procesos químicos. Procesos de transformación: inyección, soplado, extrusión. Técnicas de caracterización de polímeros en general y en particular las térmicas y mecánicas y las normas internacionales que se utilizan.

Fotografies del curs en el Departament de Química en l’Universitat d'Holguín.
· Universitat Aeronàutica de Querétaro (Mèxic)

Visita a UNAQ - Universitat Aeronàutica de Querétaro (Mèxic) per part de la Prof. M. Ll. Maspoch del 05 al 09 de novembre de 2018.

Fotografia: Prof. M. Ll. Maspoch amb el rector de la Universitat UNAQ

Es va dur a terme durant la seva estància la Firma del Conveni amb CIDESI i CENTA.
ACTIVITATS DE PROMOCIÓ

· Desenvolupament de la pàgina web del CCP

Actualització de la pàgina web: http://www.upc.edu/ccp/
Recull de premsa

· Notícia publicada el dia 30 de gener a la web del Centro Español de Plásticos (CEP) a l’apartat notícies: “El Innovation Workshop Bilbao concluye con éxito”. Es fa esmena del Centre Català del Plàstic com a centre tecnològic associat al CEP, on es fa fer una presentació del nostre centre per part del Dr. David Arencón i es van exposar els casos d’èxit de SEAT amb col·laboració amb el CCP sobre l’exploració de tecnologies de microespumació aplicades a l’automòbil.

Link per visualitzar-la: https://www.cep-plasticos.com/es/contenido/exito-de-participacion-en-el-innovation-workshop-bilbao

· Notícia publicada el dia 15 de febrer a la web del Centro Español de Plásticos (CEP) a l’apartat notícies: “El Innovation Workshop Valencia concluye con éxito”. Es fa esmena del Centre Català del Plàstic com a centre tecnològic associat al CEP, on es fa fer una presentació del nostre centre per part del Dr. David Arencón i es van exposar els casos d’èxit de SEAT amb col·laboració amb el CCP sobre l’exploració de tecnologies de microespumació aplicades a l’automòbil.

Link per visualitzar-la: https://www.cep-plasticos.com/es/contenido/el-innovation-workshop-valencia-concluye-con-exito

· Notícia publicada el dia 01 de març a la web del Centro Español de Plásticos (CEP) a l’apartat notícies: “El Innovation Workshop Zaragoza concluye con éxito”. Es fa esmena del Centre Català del Plàstic com a centre tecnològic associat al CEP, on es fa fer una presentació del nostre centre per part del Dr. David Arencón i es van exposar els casos d’èxit de SEAT amb col·laboració amb el CCP sobre l’exploració de tecnologies de microespumació aplicades a l’automòbil.

Link per visualitzar-la: https://www.cep-plasticos.com/es/contenido/zaragoza-cierra-con-exito-la-primera-edicion-de-los-innovation-workshops
RESUM

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Tesis

Visites Científiques
21ª Edición
Ciclo de especialización en plásticos

Este ciclo consta de 4 módulos individuales que ofrecen una visión amplia y actualizada de los materiales plásticos

Va dirigido a técnicos graduados en otras áreas que deseen conocer y profundizar en los principios científicos y tecnológicos en los que se basa la industria del plástico.

Cada módulo tiene una duración de 21 horas que se imparten durante 6 días a razón de 3 horas y media por día entre teoría y práctica.
(De 16.00h a 19.30h)

TECNOLÓGIA DE MATERIALES PLÁSTICOS
19, 26 de Enero, 2, 9, 16 y 23 de Febrero 2018

INYECCIÓN Y DISEÑO DE PIEZAS DE PLÁSTICO
13, 20, 27 de Abril, 4, 11 y 18 de Mayo 2018

ENSAYOS TÉRMICOS Y MECÁNICOS
25 de Mayo, 1, 8, 15, 22 y 29 de Junio 2018

EXTRUSIÓN
14, 21, 28 de Septiembre, 5, 19 y 26 de Octubre 2018

Precio ciclo completo: 1.900€
Precio por módulo: 490€
PUBLICACIONES
Revistes indexades
(al Science Citation Index)
Epoxy coupling agent for PLA and PHB copolymer-based cotton fabric bio-composites

Daniele Battagazzore\(^a\), Alberto Frache\(^b\), Tobias Abt\(^b\), Maria Lluisa Maspoch\(^b\)

\(^a\) Dipartimento di Scienze Applicate e Tecnologie, Politecnico di Torino, sede di Alessandria, Viale Teresa Michel 5, 15123 Alessandria, Italy
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1. Introduction

Composite materials are used in a wide range of industrial applications, such as air, land and sea transport, building and structural applications. Most of the commercial traditional composites are fossil fuel based synthetic materials such as epoxy, unsaturated polyester, or phenolics being reinforced with synthetic fibres like glass, carbon or aramid [1]. Such thermoset polymers with synthetic fibres have serious drawbacks in terms of their recyclability, notwithstanding the energy consumption, costs and health hazards for their production [2]. The recent discussion about the preservation of natural resources and waste reduction has carried updated interest on renewable raw materials [3-5]. Firstly, the shifting from thermoset to thermoplastic matrices has the advantage to be re-processed/reycled into different shapes, reducing the impact on the environment in relation to their disposal at the end of the product life cycle [6]. Nevertheless, the recycling process of a reinforced thermoplastic composite can become costly due to the difficulty of separating the fibre from the polymer matrix. On account of this, the bio-based and bio-degradable composites add additional opportunities for the end of life scenario [7,8]. The introduction of natural fibres from annually renewable resources are now popularly used as reinforcements in such polymer matrix to obtain a fully bio-based and biodegradable composite [9-14]. Flax [15], jute [16,17], hemp [18,19], kenaf [20-22] and cellulose [23,24] are extensively studied in PLA composites, fewer researches were made with PBS [25] or PHB matrices [26]. Generally, these fibres are used as short discontinuous reinforcement material. In these cases chopped fibres are mixed with thermoplastic polymers by melt blending and processed via injection or compression moulding. The resulting properties of these composites are, however, not as good as if long or continuous fibres were used. Notwithstanding, natural fibres are not continuous but can be processed to form yarn and fabric for textiles. Only few studies have developed woven fabric reinforced composites and have exploited the benefits of the load carrying capacity of long fibres [10].

Porras et al. [27] studied PLA reinforced with a natural fabric extracted from Manicaria Saccifera palm with a film stacking procedure and a fibre mass content of 40 wt%. They found that the tensile strength, elastic modulus and impact resistance were improved by 26%, 51% and 56% respectively. However, the elongation at break was reduced from 4.9% to 3.5%. Graupner et al. [28] prepared several fabric-PLA composites and found that the tensile strength, elastic modulus and impact resistance were marginally improved by 32%, 1% and 21% in cotton machine direction (MD) with a fibre weight content of 40%. Contrary to Porras et al., a higher elongation at break (3.1% in the MD and 1.9% in the transverse direction) compared to the pure matrix (0.8%) was measured.

In the present study, bio-based and bio-degradable thermoplastic matrices in combination with cotton fabric was investigated. The two bio-based matrices studied were poly(lactic acid) (PLA) and poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) (PHB copolymer). Cotton, the most abundant natural fibre in the world [29] in form of a twill fabric was inserted between two polymer sheets using a film stacking method [30].
Microcellular PP/GF composites: Morphological, mechanical and fracture characterization

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ABSTRACT

The aim of the present work is to analyze the morphology, mechanical properties and fracture behaviour of solid and foamed plates made of glass fiber-reinforced PP. The morphology exhibited a solid skin-/foamed core structure, dependent on the foaming ratio. Simulation of the microcellular injection molding process with Moldex 3D® software provided a good approach to the experimental results. The flexural properties and impact resistance showed lower values as the apparent density decreased, but constant specific properties. The fracture characterization was carried out by determining the Crack Tip Opening Displacement (CTOD) at low strain rate, as well as the fracture toughness (Kc) at impact loading. Foamed specimens presented higher values of CTOD than the solid ones and higher as the foaming ratio increases, due to cells acting as crack arrestors by blunting the crack tip. However, the fracture toughness Kc decreased with decreasing the apparent density. Anisotropy due to fiber orientation was also observed. Fibers were aligned in the filling direction in the surface layers, while they were oriented in the transverse direction in the core. According to the amount of fibers oriented in one direction or another, different properties were obtained.

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1. Introduction

The relative low material density and cost, easy processing and good mechanical properties of Polypropylene (PP) make it suitable for a wide range of applications. PP is widely used in automotive parts either in the form of homopolymer or copolymer with enhanced impact resistance [1]. The demand for lighter constructions and reductions in fuel consumption and greenhouse gas emissions [2] makes PP foams potentially interesting for automotive products.

Foamability of PP has been extensively studied by the way of batch methods [3], extrusion [4] and injection moulding processes [5]. Unfortunately, the low melt strength of PP and its crystalline nature results in poor cell structure [6]. Low solubility and diffusivity of blowing agents in PP have been determined [7], leading to inhomogeneous morphology along the part. On the other hand, the weak melt strength promotes cell walls breakage under elongational forces while processing, causing cell coalescence, open-cell structures and decrease of mechanical properties [8].

Different methods have been conducted aimed to improve cell nucleation behavior and melt strength of PP, such as long-chain branching [9], ramified molecular structures [8,10] and blending with other polymer [11]. Furthermore, it has been reported that inorganic fillers dramatically enhance cell structure of foamed polymers acting as nucleating agents. Leung et al. [12] showed that additives with many crevices of small semicircular angles lead to higher quality polymer foams, with a high cell density, a smaller cell size and narrower cell size distribution. Some of the most common fillers, namely talc, calcium carbonate, silica and carbon fibers have been successfully employed to the formation of fine and uniform cell morphologies [13,14], as well as wood fibers, clay and rubber particles [15–18]. Among the different fillers, glass fibers (GF) are the most common reinforcement for polymeric matrix composites, having an excellent relationship between low cost, high stiffness and strength, high chemical resistance, and insulating properties, but with the disadvantages of low tensile modulus, relatively high specific gravity, sensitivity to abrasion during handling, low fatigue resistance and high hardness [19]. They have been traditionally utilized in many industrial applications due to the increase in stiffness and strength of reinforced thermoplastics, creep resistance and service temperature. Regarding foaming experiments with PP/GF composites, Xi et al. [20] determined an
Effects of Carbon Nanotubes/Graphene Nanoplatelets Hybrid Systems on the Structure and Properties of Polyetherimide-Based Foams

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Abstract: Foams based on polyetherimide (PEI) with carbon nanotubes (CNT) and PEI with graphene nanoplatelets (GnP) combined with CNT were prepared by water vapor induced phase separation. Prior to foaming, variable amounts of only CNT (0.1–2.0 wt %) or a combination of GnP (0.0–2.0 wt %) and CNT (0.0–2.0 wt %) for a total amount of CNT-GnP of 2.0 wt %, were dispersed in a solvent using high power sonication, added to the PEI solution, and intensively mixed. While the addition of increasingly higher amounts of only CNT led to foams with more heterogeneous cellular structures, the incorporation of GnP resulted in foams with finer and more homogeneous cellular structures. GnP in combination with CNT effectively enhanced the thermal stability of foams by delaying thermal decomposition and mechanically-reinforced PEI. The addition of 1.0 wt % GnP in combination with 1.0 wt % CNT resulted in foams with extremely high electrical conductivity, which was related to the formation of an optimum conductive network by physical contact between GnP layers and CNT, enabling their use in electrostatic discharge (ESD) and electromagnetic interference (EMI) shielding applications. The experimental electrical conductivity values of foams containing only CNT fitted well to a percolative conduction model, with a percolation threshold of 0.06 vol % (0.1 wt %) CNT.

Keywords: nanocomposites; graphene; carbon nanotubes; hybrid nanoparticles; polyetherimide foams; electrical conductivity; percolation; ultrasonication

1. Introduction

Polyetherimide (PEI) has recently become popular for use in advanced applications, due to its outstanding combination of high mechanical properties, flame and chemical resistance, and high thermal and dimensional stability. The preparation of PEI-based foams reinforced with carbon-based nanoparticles using water vapor induced phase separation (WVIPS) has shown promising results in terms of homogeneity and filler dispersion [1–4]. The addition of carbon-based nanofillers to PEI has created a suitable candidate for various advanced applications, such as fuel cells and electromagnetic interference (EMI) shielding [5–7]. Additionally, foaming could facilitate desirable features such as density reduction, damping properties, high thermal insulation, and the potential improvement of electrical conductivity and electromagnetic absorption by promoting wave scattering [7–9]. The combination of functional nanoparticles and foaming has a high potential to generate new lightweight composites with high specific strength and multifunctionality [10]. Simultaneous enhancements in electrical and mechanical properties, with the addition of carbon-based nanosized fillers such as graphene nanoplatelets (GnP) or carbon nanotubes (CNT), owing to their high aspect ratio (AR) and exceptional mechanical and electrical properties, have brought important advantages over non-carbon-based nanofillers [11–13].
Polypropylene-Based Porous Membranes: Influence of Polymer Composition, Extrusion Draw Ratio and Uniaxial Strain

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Abstract: Several commercial grades of homo-polymer and its blends were selected to prepare microporous membranes through melt extrusion-annealing-uniaxial stretching technique (MEAUS). Branched or very fluid polypropylene was employed to modify the polymeric composition. In some blends, micro-sized calcium carbonate was added. We analysed the influence of sample composition, extrusion draw ratio, and we performed a deep study concerning the uniaxial strain rate, using in some cases extreme strain rates and strain extents. The crystalline features were studied by Differential Scanning Calorimetry (DSC), and the morphology of porous structure was analyzed through Scanning Electron Microscopy (SEM). Thermal stability and thermomechanical performance was measured by thermogravimetric analysis (TGA) and dynamic-thermal (DTMA) study. A close relationship was found between crystalline characteristics, porous morphology and the trends registered for permeability.

Keywords: polypropylene-based membranes; extrusion; porous morphology

1. Introduction

Polypropylene (PP) membranes have been studied by several authors due to their wide use for commercial separation processes. Membranes can be formally categorized in different classes according to their chemical and physical characteristics and how they operate. The industrial membrane technologies can be classified based on the average pore diameter as follows: conventional filtration (10–100 μm), microfiltration (0.1–10 μm), ultrafiltration (1–100 nm) and reverse osmosis (~0.1 nm) [1]. Furthermore, polypropylene is a good candidate for certain industrial applications such as gas separation, Li-ion batteries or medical applications, due to its outstanding properties such as high melting temperature, chemical resistance and good mechanical properties [2,3].

Polymeric membranes are conventionally produced using the phase inversion process, in which solvents are used to form the pore network. To avoid the use of solvents, due to their cost, environmental footprint and contamination risks, a dry process based on the stretching of extruded film with a specific structure called MEAUS (melt extrusion-annealing-uniaxial stretching) was developed in recent decades. This process is applicable to semi-crystalline polymers, and three consecutive stages are carried out: (a) fabrication of a precursor film with a row-nucleated lamellar structure; (b) annealing the film to increase the lamellar thickness and removes defects in the crystalline phase; (c) stretching the annealed film at low and high temperatures to create and enlarge the pores [4–26].
Effect of the viscosity ratio on the PLA/PA10.10 bioblends morphology and mechanical properties

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Abstract. PLA bio-blends with a predominantly biosourced PA10.10 in the composition range 10–50 wt% were prepared by melt blending in order to overcome the advanced brittleness of PLA. Due to the inherent immiscibility of the blends, 30 wt% of PA was needed to achieve a brittle-to-ductile transition and a co-continuous morphology was predicted at 58 wt% of PA. The initial enhancement of the PLA rheological behaviour through the environmentally friendly reactive extrusion process yielded a finer and more homogeneous microstructure and hence enhanced the mechanical properties of the bioblends at much lower PA contents. The brittle-to-ductile transition could be achieved with only 10 wt% and co-continuity was observed already at 44 wt% of PA. Results indicate the significant potential of modifying PLA flow behaviour as a promising green manufacturing method toward expanding PLA-based bio-blends applications.

Keywords: biopolymers, rheology, material testing, mechanical properties

1. Introduction

Poly (lactic acid) (PLA) is the front runner in the emerging bio-based and compostable plastic market. Initially, PLA has been viewed as a good alternative to commercial polymers for commodity applications (i.e. packaging). Unfortunately, its advanced brittleness at room temperature (RT) has been its major disadvantage for its implementation into high-value and durable applications (i.e. electronic or automotive). Blending PLA with other engineering soft polymers represents an industrially relevant strategy for developing bio-based formulations with tailored performances [1]. Specifically, numerous works report the investigation of melt blending PLA with polyamides (PA) [2–7]. However, the inherent immiscibility of this binary polymer system results in rather poor mechanical properties. To overcome the aforementioned issue, Pui et al. [3] as well as Patel et al. [7] reported the first intents to compatibilize PLA/PA blends by adding titanium isopropoxide and a low molecular weight (Mₘ) epoxy resin, respectively. Unfortunately, a high PA content (≥50 wt%) is needed to change the blend morphology from droplet-matrix to co-continuous in order to improve the mechanical properties [4, 6, 7]. Therefore, PLA/PA blends with a predominant PLA content still exhibit brittleness. Polymer blends exhibiting a fine-tuned morphology with a significant reduced droplet size of the minor phase are promising due to their enhanced toughness in comparison to coarse sea-island morphologies [8]. Nuzzo et al. [6] reported the use of a third component (i.e. nanoparticles) in PLA/PA11 blends to both
Notch effect on the fracture of a polymeric film

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ABSTRACT

The fracture behavior of a bio-based thermoplastic copolyester film has been studied by combining the essential work of fracture, the J-integral, and the crack tip opening displacement characterization methods on double edge notched tension specimens, in an attempt to provide a better understanding of the details that play an important role in the repeatability and the reproducibility of the essential work of fracture test, with particular attention to the effect of the quality of the notches generated by two different notch sharpening techniques. Specifically, the femtosecond pulsed laser ablation and the classic razor blade sliding techniques have been applied. The equivalence, reported and discussed in the literature, between the specific essential work of fracture and the J value at crack initiation, as well as their relationship with the crack tip opening displacement, have been confirmed. It is also identified the parabolic shape of the stress-displacement curves, which modeled relates the specific non-essential work of fracture with the stress at initiation and the extension ratio during the crack growth.

1. Introduction

Films of polymers are used in a wide variety of applications. Their toughness is often a basic requirement to meet some applications. The Linear Elastic Fracture Mechanics (LEFM) approach is used to study fractures occurring at nominal stresses well below the material’s yield stress. The main assumption of LEFM is that the dissipated energy is confined to a small area near the crack tip (small scale yielding), and that brittle fracture occurs without extensive plastic deformation. LEFM characterizes toughness using the critical stress intensity factor (Kc), and the energy released per unit area of crack growth (Gc), at fracture initiation. There is a direct relationship between both parameters.

The LEFM approach is not applicable when the plasticity around the crack tip becomes too large; in those cases Elastic Plastic Fracture Mechanics (EPFM) applies and the crack tip opening displacement (CTOD) and J-integral are appropriate methods to characterize fracture. Based on the deformation theory of plasticity, Cherepanov [1] and Rice [2] developed a new fracture parameter, the J-integral. This theoretical concept represents an energy contour path integral that is independent of the path around the crack, parameter which characterizes fracture under elastic-plastic and fully plastic conditions. Begley and Landes [3] applied the J-integral principle and developed a measurement of the fracture toughness which represents the energy required to initiate crack growth, which can be expressed as

\[ J = -\frac{1}{1} \int \frac{dU}{da} \left|_(\)_{\text{remote}} \right. \]

where U is the external work done up to a given constant displacement, d, and a is the crack length.

Another important concept, first proposed by Wells in 1963 [4], is the CTOD. This method is used to determine a fracture parameter for ductile materials. It essentially measures the resistance of the material to the propagation of a crack. A direct relationship between the J-integral and CTOD concepts exists.

When the crack propagates through a highly deformed and yield material, then Post-Yield Fracture Mechanics (PYFM) can also be applied and the Essential Work of Fracture (EWF) is a suitable method for characterizing fracture. For ductile polymers where crack propagation occurs through a fully yielded ligament, the EWF, the CTOD, and the J-integral methods are commonly used. The EWF method is becoming more widely used to characterize the plane stress toughness of ductile polymer films in mode I, primarily using the double edge notched tension (DENT) configuration. The widespread use of the EWF technique is due to the apparent ease with which DENT specimens may be prepared and tested.

It has been experimentally found that in the specific energy just up to crack initiation, is equivalent to the J-integral [5-8] value at crack initiation in plane stress, \( J_{\text{int}} \), when the complete ligament yielding of the
Poly(Amide-imide) Aerogel Materials Produced via an Ice Templating Process

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Abstract: Low density composites of sodium montmorillonite and poly(amide-imide) polymers have been created using an ice templating method, which serves as an alternative to the often-difficult foaming of high temperature/high performance polymers. The starting polymer was received in the poly(amic acid) form which can be cured using heat, into a water insoluble amide-imide copolymer. The resulting materials have densities in the 0.05 g/cm³ range and have excellent mechanical properties. Using a tertiary amine as a processing aid provides for lower viscosity and allows more concentrated polymer solutions to be used. The concentration of the amine relative to the acid groups on the polymer backbone has been found to cause significant difference in the mechanical properties of the dried materials. The synthesis and characterization of low density versions of two poly(amide-imide) polymers and their composites with sodium montmorillonite clay are discussed in the present work.

Keywords: aerogel; clay; composite; poly(amide-imide); mechanical properties

1. Introduction

Polymer aerogel represent a family of low density materials which are typically produced by either supercritical or freeze drying of wet gels [1,2]. The supercritical drying process developed from early work by Kistler [3], who showed that colloidal silica could be generated via a sol-gel process in an alcohol, solvent exchanged with acetone, then dried using supercritical carbon dioxide. Meador [4], Leventis [5] and others have expanded the field to generate polymer-based aerogels in a similar manner. A great advantage of the supercritical drying approach is that the exquisite structure generated in the wet gel state can be preserved in the finished aerogel, producing materials of high surface area and nanoporosity, leading to material with exceptional thermal insulative properties. Downsides to the use of the supercritical process include the handling and removal of large quantities of organic solvents, and use of capital-intensive supercritical carbon dioxide drying. The freeze drying process for producing aerogels produces low density materials whose structures are not dominated by the delicate gel structure of wet gels, but rather materials whose structures are the negatives of the frozen ice structure; polymers and fillers are forced into the grain boundaries of the ice lattice, which is then sublimed away to leave a porous material behind [6]. Because the materials produced using such an ice templating method are coarser than those generated using supercritical drying, they tend to possess lower surface areas, lack nanoporosity, and exhibit typical polymer foam-like thermal conductivities [7]. The freeze drying process benefits from the use of water as solvent and simplicity in the freeze drying process, and is amenable to a wide range of polymers, such as poly(vinyl alcohol) [8] and bio-based alginate [9], casein [10], pectin [11], gelatin [12], natural rubber [13] and hyaluronic
Multivariable methods applied to FTIR: A powerful technique to highlight architectural changes in poly(lactic acid)

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A B S T R A C T

The structural modifications of a commercially available poly(lactic acid) grade were induced through reactive extrusion using a multi-epoxide reactive agent in a pilot plant. The statistical nature of the chemical reactions led to the generation of several types of non-uniform molecular architectures. Even though conventional spectroscopic (NMR) or chromatographic (SEC-static light scattering) techniques are placed at the forefront of the molecular characterization, both methods usually failed in characterizing non-uniform structures. In this study, a promising approach was applied to automatically classify modified PLA samples. It is based on the analysis of FTIR spectral data by means of multivariable methods, including feature extraction and classification algorithms. The fast and accurate results presented in this paper show the potential of the proposed approach.

1. Introduction

Among biodegradable polymers, poly(lactic acid) (PLA) has been viewed as a promising alternative to petroleum-based commodity polymers (PET, PS, etc.). Nevertheless, the use of PLA in some specific processing techniques (i.e., sheet casting, extrusion, blown film, foaming) is complicated. This is due to its limited melt strength and elasticity, as well as its insufficient thermal stability at high temperatures. On this basis, reactive extrusion (referred to as REX), combined with a multifunctional reactive agent, has been considered as a promising method to both stabilize and enhance PLA melt properties [1,2]. Among the most commonly used chain extenders, the different reactive species able to react with PLA functional end groups (i.e., COOH and OH) are epoxy [3], isocyanate [4], anhydride [5] and isocyanurate [5,6] functions.

Until today, a styrene-acrylic multifunctional epoxy random oligomer (SAmE) has been reported to be the most effective reactive agent to enhance both the melt strength and the thermal stability of PLA during processing [3,7]. This is due to the possible chemical bonding of several PLA chains to one SAmE molecule, thus leading to the formation of branched macromolecules, which potentially hold long chain branches (LCB). However, due to the statistical nature of the chemical bonding coupled with a possible competition between chain degradation, chain extension, and chain branching, the topological modifications induced in the initial PLA matrix are not trivial. It would be a mixture of several types of nonuniform structures in molecular weight (MW), in architectures and in the number of branch per macromolecules.

Conventional spectroscopic (i.e. NMR) or chromatographic (i.e. SEC-static light scattering, SEC-LS) techniques are usually placed at the forefront of the molecular characterization. Unfortunately, both methods are likely to exhibit a limited sensitivity for non-uniform LCB PLA macromolecules, as already reported elsewhere [7]. While the former cannot distinguish branches of six carbon atoms length and longer, as largely reported for polyolefins [8], unreliable LS data are expected using the latter due to the extremely small refractive index increment value (dn/dc ~ 0.024 ml g⁻¹ in chloroform [9]) exhibited by PLA. Fourier Transform Infrared Spectroscopy (FTIR) is another method to evidence possible coupling reactions between PLA functional end groups and the epoxy groups of the SAmE. Nevertheless, unreliable results are usually obtained due to a content of new covalent bonding, possibly below the detection limits of this technique. That is, the identification of possible subtle differences between raw FTIR data is not trivial.

As the literature reports, multivariable mathematical methods applied to FTIR is a promising technique to identify slight differences between spectra. The computing analysis of principal components (PCA) together with canonical variables (CVA) has already been successfully used in food authenticity testing, the rubber industry and paper identification, among others [10-14]. FTIR is a non-destructive technique, which makes it a suitable tool for process control applications in industrial settings. Accordingly, this works aims at evaluating...
Material Behaviour

Poly(lactic acid) and acrylonitrile – butadiene – styrene blends: Influence of adding ABS–g–MAH compatibilizer on the kinetics of the thermal degradation

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\textbf{ABSTRACT}

Square plates (nominal thickness: 3 mm, nominal width: 100 mm) of different rheologically modified PLA/ABS blends were manufactured through injection molding, with or without adding ABS grafted with maleic anhydride (MAH). During processing, the properties of the melt were stabilized and enhanced by the addition of a styrene-acrylic multi-functional epoxide oligomeric reactive agent (SiAmfE). PLA-REX was obtained by reactive extrusion of PLA. A general analytical equation was used in order to evaluate the kinetic parameters of the thermal degradation of PLA–REX/ABS and PLA–REX/ABS–ABS blends through thermogravimetric analysis. The thermal degradation of these blends occurred through two different reaction steps. Various empirical and theoretical solid-state mechanisms were tested to elucidate the best kinetic model. In order to reach this goal, plots of standardized conversion functions were constructed. Given that it is not always easy to visualize the best accordance between experimental and theoretical values of standardized conversion functions, a recently proposed index was determined to quantitatively identify the best mechanism. By doing that, it has been possible to determine the right activation energy of the thermal degradation. It has been demonstrated that the best mechanisms for these materials were B2 (i.e. phase-boundary-controlled reaction (contracting area)) for the first step (α < 60%) and F3 (i.e. three order reaction) for the second one (α > 70%). The thermal stability of PLA–REX/ABS blend was greatly improved by adding the ABS–g–MAH compatibilizer. These findings were also confirmed by means of morphological characterization through scanning electron microscopy.

1. Introduction

Poly (lactic acid) (PLA) is a well-known biodegradable polyester derived from renewable resources that, due to its biodegradable condition, has attracted considerable interest both in academia and industry. Although PLA shows adequate balance of properties, to extend its applications, it is necessary to improve some of them, such as thermal or toughness resistance. The thermal resistance of PLA can be enhanced by increasing its crystalline fraction, for instance, by physical blending with poly-ε-lactide (PDLA) to form a highly regular stereo-complex, where PDLA can act as a nucleating agent or by the use of heterogeneous nucleating agents. However, in most cases, the high cooling rate of the injection molding process [1] makes it difficult to obtain molded PLA articles with a high crystallinity level. Therefore, further processing steps, such as annealing treatments, are necessary to increase the crystal fraction [2]. On the other hand, the inherent brittleness is not changed or is even increased due to the high crystalline level, making the material unsuitable for common uses. Finally, the high cost of PLA production is probably the most important barrier for the practical application of this solution.

Among the different approaches followed, melt blending probably represents the most straightforward method to modify PLA properties. A review of the different approaches has been summarized by Klouery et al. [3]. Most of the attempts to modify PLA properties, through melt-blending, have been directed to increase toughness, basically combining PLA with flexible polymers, including poly-ε-caprolactone) [4], poly (ether)urethane [5] or polybutylene adipate-co-terephthalate (PBAT) [6]. However, these solutions yield a decrease in the maximum allowable temperature that the blends can withstand. On the other hand, fast PLA degradation during melt blending is an undesirable side effect that needs to be controlled [7].

Previous research carried out in our group showed that the presence of a multifunctional epoxide-type oligomer during melt blending contributed to minimize PLA degradation via chain extension [8,9]. In this
Influence of injection molding parameters on the morphology, mechanical and surface properties of ABS foams

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Abstract
In this work, microcellular ABS foams were studied. A series of injection molding samples defined by a design of experiments was carried out to analyze the effect of shot volume, mold temperature, and injection velocity on the morphology, mechanical properties, and surface roughness of microcellular samples. A predominant influence of shot volume on the cell structure and tensile properties was evidenced. Higher cell densities and narrower cell size distributions were obtained at lower injection volume. However, elastic modulus and tensile strength were improved by increasing the shot size. The effect of mold temperature and injection velocity was secondary. Higher levels of mold temperature and injection rate provided finer cell morphologies, but their effects on the elastic modulus and tensile strength were negligible. The decrease in shot volume and increase in gas content led to poor surface quality, whereas it was greatly improved by raising both mold temperature and injection velocity.

KEYWORDS
Foams, injection molding, mechanical properties, morphology, surfaces

1 INTRODUCTION

Lightweight design is one of the most important challenges in automobile industry, due to regulatory constraints and the aim of reducing weight, energy consumption, and greenhouse gas emissions. Among the different strategies conducted to achieve lighter automobiles, car manufacturers focus their efforts on replacing metals with polymers and increasing the specific strengths and rigidities of polymers.\(^1\)

Injection molding is one of the most common methods for large-scale production of thermoplastic parts. Thus, foaming by injection molding techniques, such as the microcellular injection molding \(\text{MnCell}^\text{TM}\) process (Trexl Inc.), arises as a great chance to reduce weight in plastic components. Indeed, Eldabe et al.\(^2\) as well as Kim and Wallington\(^3\) found that, by microcellular injection molding, it is possible not only to lighten industrial components, but also to decrease carbon footprint and emissions. The \(\text{MnCell}^\text{TM}\) technology is a physical foaming method consisting of four main steps: gas dissolution, cell nucleation, cell growth, and shaping in the mold. First, the gas is dissolved at supercritical pressure and temperature in the molten polymer in the barrel of the injection molding machine. When the gas/polymer single-phase solution fills the mold, the pressure drop induces a thermodynamic instability promoting the nucleation of millions of cells. These cells grow and expand by diffusion of the gas into already existing bubbles, until the polymer solidifies shaping the final part. As a result, lighter, cheaper, and more environmentally friendly components are produced, with improved dimensional stability and reduced cycle time.

The final quality of the conventional injection molded parts is influenced by several factors, such as the material, the model design, and process conditions. The introduction of gas in microcellular injection molding increases the number of variables controlling the manufacturing process. Many investigations have been carried out on the relationship between processing parameters, cell structure, and mechanical properties of different foamed materials, including
Porous Membranes Based on Polypropylene-Ethylene Copolymers. Influence of Temperature on Extrusion, Annealing and Uniaxial Strain Stages

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Abstract: In this study, block and random copolymers of polypropylene-ethylene are selected to prepare porous membranes through the melt extrusion-annealing-uniaxial stretching technique (MEASU), at a constant draw ratio. In some cases, these copolymers were blended with a homopolymer grade. The variation of temperature in the stages of extrusion, annealing and uniaxial strain was analysed. Several characterisation techniques were employed to study this influence. The crystalline orientation was analysed by polarised infrared spectroscopy (FTIR), and crystalline features were studied by differential scanning calorimetry (DSC). The thermal stability of the membranes was checked by thermogravimetric analysis (TGA). Tensile tests were performed to ascertain the stiffness and ductility of the produced samples. The results were correlated with the porous morphology, global porosity, and permeability to air. A close relationship was found between crystalline characteristics, porous morphology and the trends registered. An improved pore distribution along the membrane surface was found when copolymers were employed.

Keywords: porous membranes; polypropylene-ethylene; extrusion

1. Introduction

Polymeric microporous membranes are conventionally produced by two main techniques, one based on phase inversion process and the other is via melt processing extrusion, where a semi-crystalline polymer film with a specific structure is uniaxial stretched in order to create the porous morphology. This stretching method is commonly called MEASU (melt extrusion-annealing-uniaxial stretching) and consists of three consecutive steps: (a) Melt extrusion of a precursor film with a row-nucleated lamellar structure; (b) annealing of the film to increase the lamellar thickness and remove irregularities; and (c) stretching of the annealed film at room and high temperature to create pores and enlarge their size [1–21]. Finally, the membranes should be heat-set to prevent shrinkage and to maintain the mean pore size constant [5,21].

Semi-crystalline homopolymers as polypropylene (PP) or polyethylene (PE) have been commonly employed to produce microporous membranes via MEASU methodology. The use of this stretching process also facilitates the incorporation of mineral fillers to improve membrane performance [22–25]. Due to properties such as chemical and mechanical resistance, these polyolefins are used in a broad range of separation processes such as lithium batteries or gas/water filtration [26–29]. Overall, porosity and permeability properties are dependent on various factors. For example, control of molecular weight and polymer architecture to create a suitable lamellar structure, influence of different annealing time and
Flame retardancy effect of combined ammonium polyphosphate and aluminium diethyl phosphinate in acrylonitrile-butadiene-styrene

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ABSTRACT

The present work investigates the fire retardancy mechanisms of ammonium polyphosphate (APP) and aluminium diethyl phosphinate salt (AIP) in an acrylonitrile-butadiene-styrene copolymer (ABS) by analysing the pyrolysis, flammability and fire behaviour. Evidence of synergy in flammability by combining both flame retardants were discussed and related to the flame retardant mechanisms assessed by means of TGA and FT-IR analysis of the pyrolysis gasses. Specifically, the ABS flame retardant formulation with a 12.5 wt% APP and 12.5 wt% AIP (ABS-APP/AIP) reached a UL-94 V-0 classification, unlike the ABS with 25 wt% APP (ABS-APP) and ABS with 25 wt% AIP (ABS-AIP) formulations, which completely burned. Under forced flame conditions, APP and AIP showed, respectively, a main condensed and gas phase-based mode of action in the ABS matrix, whereas, a combined gas and condensed mode of action was identified when both additives were simultaneously incorporated. Also, the ABS-APP/AIP formulation showed the higher reduction of the peak heat release rate (74%) and of the maximum average rate of heat emission (65%), obtained from cone calorimeter tests. As well as, a more protective fire residue with an improved microstructure assed by SEM.

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1. Introduction

Acrylonitrile-butadiene-styrene (ABS) due to its high toughness and impact strength, chemical resistance advantages and good processability is commonly used as an engineering thermoplastic for several industrial and domestic appliances. However, one of the main drawbacks of ABS is its inherent flammability and dripping, which could limit its applications [1,2]. Environmental considerations has given way for the increased use of phosphorus-based flame retardants (PFR) as alternatives to the halogen-containing compounds [3], traditionally used as flame retardants for ABS [4–7], and in the past decades, high melt temperature and soluble PFR have been used [8–11]. They exhibit all kinds of flame retardant modes of action, such as flame inhibition in the gas phase, char enhancement, and intumescence and formation of inorganic glass in the condensed phase [12].

It has been found that PFR effectiveness depends on the polymer matrix [13,14]. Polymers with oxygen and/or nitrogen on their structure interact more favorably with these additives, leading to an improvement of the fire behaviour [15]. Kim et al. [16], found that such effectiveness strongly depends on the P content and that a 5 wt% P is required to observe an exhibit self-extinguishing behaviour in ABS. Moreover, Rabe et al. [12] found the existence of a critical content of PFR, from which the level of degradation changes significantly up to the retention of incompletely pyrolyzed polymer due to a protective layer.

Several works have been published related with the flame retardant efficiency of ammonium polyphosphate (APP) on non-charring and self-charring polymers [17–20], where it has been proved that APP has a major role in the condensed phase [15]. The efficiency and mechanism of action of diethyl aluminium phos- phinate (AIP) have been less studied, and it has been found to be dependent of the polymer matrix [16]. Sullalil et al. [21] reported that AIP acted mainly in the condensed phase, forming a consistent amount of char in PBT. Braun et al. [22] reported that AIP had a higher effect in the gas phase in PAM6 through the release of diethylphosphoric acid, providing flame inhibition. Similar effects were observed in a thermoplastic elastomer-based multistystem.

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Enhancing the Electrical Conductivity of Polyetherimide-Based Foams by Simultaneously Increasing the Porosity and Graphene Nanoplatelets Dispersion

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Significant improvement in electrical conductivity of graphene nanoplatelets-filled polyetherimide (PEI) foams was achieved by simultaneously increasing the porosity and graphene nanoplatelets dispersion. Foams were prepared by means of water vapor-induced phase separation using a concentration of graphene nanoplatelets (GnP) between 1 and 10 wt%. To obtain two sets of foams having different density and porosity, PEI's concentration in N-methyl pyrrolidone (NMP) solvent prior to foaming was set at 15 and 25–30 wt%, respectively. High-power sonication was applied to GnP-NMP suspension before PEI’s addition for the foam series with higher porosity (15 wt% PEI). All foams were later characterized in terms of cellular structure, thermal stability, dynamic-mechanical properties, and electrical conductivity. A notable enhancement in electrical conductivity was observed with foaming, especially when increasing the porosity and applying sonication, with foams reaching values as high as 1.7 × 10⁻¹ S/m while maintaining the thermal stability and mechanical performance. POLYM. COMPOS., 2018. © 2018 Society of Plastics Engineers

INTRODUCTION

Polyetherimide (PEI) is one of the most used high-performance thermoplastic polymers in advanced applications due to its outstanding combination of high mechanical performance, flame and chemical resistances, and thermal and dimensional stabilities. The preparation of PEI-based foams reinforced with carbon-based nanoparticles using water vapor induced phase separation (WVIPS) has shown promising results in terms of homogeneity and filler dispersion [1–4]. Other foaming methods such as solid state and microcellular injection molding have also been used to investigate the effects of fillers such as multi-wall carbon nanotubes (MWCNT), montmorillonite (MMT), or tale [5].

Liquid-phase exfoliation has raised a lot of attention in past years due to its potential industrial scalability [6]. The exfoliation of graphene nanoplatelets stacks in liquid environments can be realized by the application of ultrasounds and graphene layer stabilization using organic solvents [5]. Solvent selection is highly dependent on the interfacial tension between solid and liquid. A high interfacial tension results in poor dispersion of the solid in the liquid due to the high energy value of work of cohesion and restacking [7]. Consequently, solvents with a surface tension close to 40 mJ m⁻²—for example, N-methyl pyrrolidone (NMP) with 40 mJ m⁻² and N,N-dimethylformamide (DMF) with 37.1 mJ m⁻²—have proven suitable for graphene dispersion due to the reduction of the interfacial tension between solvent and graphene [6]. Additionally, NMP has shown a promising level of solubility for a vast range of high-performance polymers, such as PEI. In the case of the WVIPS foaming method, although providing a high level of homogeneity, the kinetic of the process is not capable of providing the required conditions to properly separate the graphene layers. A possibility to counteract this limitation and provide the required energy for breaking the van der Waals forces keeping together the graphene layers could be the application of ultrasonication to the GnP-solvent suspension prior to foaming [8–10].

Proper dispersion of conductive nanofillers is known to be crucial in optimizing the transport properties of polymer nanocomposites. In a previous work, we reported that graphene-filled PEI foams prepared by WVIPS presented promising electrical conductivity values while enhancing the mechanical and thermal properties of the base material [1]. Another research conducted by Ling et al. [2] showed that foaming led to improvements in the electrical conductivity of PEI–graphene nanocomposite foams prepared by a similar procedure. Their measurements revealed that while the addition of 10 wt% graphene already led to significant enhancements in electrical conductivity, PEI–graphene nanocomposites reaching electrical conductivities as high...
Effects of a Phosphorus Flame Retardant System on the Mechanical and Fire Behavior of Microcellular ABS

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Abstract: The present work deals with the study of phosphorus flame retardant microcellular acrylonitrile-butadiene-styrene (ABS) parts and the effects of weight reduction on the fire and mechanical performance. Phosphorus-based flame retardant additives (PFR), aluminum diethylphosphinate and ammonium polyphosphate, were used as a more environmentally friendly alternative to halogenated flame retardants. A 25 wt % of such PFR system was added to the polymer using a co-rotating twin-screw extruder. Subsequently, microcellular parts with 10, 15, and 20% of nominal weight reduction were prepared using a MuCell® injection-molding process. The results indicate that the presence of PFR particles increased the storage modulus and decreased the impact energy determined by means of dynamic-mechanical-thermal analysis and falling weight impact tests respectively. Nevertheless, the reduction of impact energy was found to be lower in ABS/PFR samples than in neat ABS with increasing weight reduction. This effect was attributed to the lower cell sizes and higher cell densities of the microcellular core of ABS/PFR parts. All ABS/PFR foams showed a self-extinguishing behavior under UL-94 burning vertical tests, independently of the weight reduction. Gradual decreases of the second peak of heat release rate and time of combustion with similar intumescent effect were observed with increasing weight reduction under cone calorimeter tests.

Keywords: flame-retardant ABS microcellular foams; phosphorus flame retardants; MuCell® injection-molding foaming

1. Introduction

Acrylonitrile-butadiene-styrene (ABS) is one of the most used engineering polymers due to its good combination of properties and low cost, being widely used in different industrial areas such as in the automotive sector, building, and construction, as well as in electrical and electronic applications. In the automobile sector, ABS is commonly used for interior and exterior car parts due to its high thermal insulation performance and the fact that its electrical properties do not change significantly with temperature and humidity [1]. Nevertheless, its high flammability with release of gases and toxic fumes during combustion significantly limits its use for this type of application.

Traditionally, the flame retardancy enhancement of polymeric materials such as plastics, foams, resins, and adhesives has been achieved through the use of brominated flame retardant additives. These materials were introduced in the 1960s and 1970s and are very effective at low concentrations [2]. However, the use of these halogenated flame retardants was demonstrated in the 1990s to adversely affect the environment due to high toxicity and bioaccumulation. In the past decade, the use of such additives has been highly limited due to European environmental restrictions [3], in some cases even
The effect of fatty acids on the physicochemical properties of edible films composed of gelatin and gluten proteins

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ABSTRACT

In this study, edible films were prepared with different wheat gluten (GLU) and gelatin (GEL) ratios by the solvent casting technique using glycerol (GLY) or sorbitol (SOR) as plasticizers. Fatty acids (caproic, caprylic, capric, lauric, myristic or palmitic) were also added to a previously selected GLU/GEL/sorbitol film, and the effect of GLU:GEL proportion and type of fatty acid on the film properties were tested. Films plasticized with GLY presented a more significant reduction in the elongation at break (EB). In contrast, films plasticized with SOR did not show a significant difference in the EB. The film's water vapor permeability (WVP) and acid solubility increased with increasing proportions of GEL while the water solubility was decreased. On the other hand, the elongation at break of the films decreased with increasing GEL content, which may be associated with its more rigid structure. The addition of fatty acids resulted in lower WVP and the plasticizing effect was dependent on the degree of interaction with the proteins of the film (identified by thermal analysis). The GLU:GEL proportion and the type of fatty acid affect the film properties (mechanical, solubility, opacity, water vapor barrier), allowing the development of new materials with different and useful functional properties according to the desired application.

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1. Introduction

Edible packaging has been recognized as a potential alternative to conventional packaging since it reduces waste and may improve product stability, quality and safety (Janjarasjuti & Krochta, 2010). They provide a semi-permeable barrier against oxygen, carbon dioxide and moisture, reducing respiration, water loss and oxidation rates (Lee, Park, Lee, & Choi, 2003). These last generations of edible films are not expected to replace petrochemical polymer films, but they can help in limiting moisture, aroma, and lipid migrations within composite foods or between food and headspace of conventional packaging (Benthetah, Gay, Karbowiak, & Debeaufort, 2016; Vieira, Silva, Santos, & Beppu, 2011). Edible coatings may be prepared from proteins (eg. gluten and gelatin), polysaccharides, lipids and combination of edible constituents (Fakhouri et al., 2012; Han, Hwang, Min, & Krochta, 2008; Martelli et al., 2017; Moore, Martelli, Gandolfo, Sobral, & Borges Laurindo, 2006).

Gluten proteins are plant proteins and consists of monomeric gliadins and polymeric glutenin (Shewry, Halford, Belton, & Tatham, 2002). They are divided into two groups based on their extractability in aqueous alcohol: the gliadins (extractable) and glutenins (non extractable) (Shewry & Tatham, 1997). The cohesiveness and elasticity of gluten provide integrity and facilitate film formation. Wheat gluten-based films exhibit significant gas-barrier properties and selectivity at high relative humidity (RH) (Angellier-Coussy, Torres-Giner, Morel, Gontard, & Gastaldi, 2008). The mechanical properties of gluten-based films are strongly affected by pH and gluten concentration while water vapor permeability may be correlated with pH and ethanol level (Gontard, Duche, Cuq, & Guibert, 1994). Although the effects of plasticizers and hydrophobic constituents on properties of these...
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The Relation between the Rheological Properties of Gels and the Mechanical Properties of Their Corresponding Aerogels

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Abstract: A series of low density, highly porous clay/poly(vinyl alcohol) composite aerogels, incorporating ammonium alginate, were fabricated via a convenient and eco-friendly freeze drying method. It is significant to understand rheological properties of precursor gels because they directly affect the form of aerogels and their processing behaviors. The introduction of ammonium alginate impacted the rheological properties of colloidal gels and improved the mechanical performance of the subject aerogels. The specific compositions and processing conditions applied to those colloidal gel systems brought about different aerogel morphologies, which in turn translated into the observed mechanical properties. The bridge between gel rheologies and aerogel structures are established in the present work.

Keywords: aerogel; rheology; mechanical properties

1. Introduction

The interdependence of processing, structure, properties, and performance of materials can be described using an optimization loop, as shown in Figure 1 [1,2]. The strategy in developing new materials, then, requires consideration of a multilevel structure, which leads a series of properties, characteristics, or behaviors in a certain environment, necessary to meet desired product performance [3].

Aerogels, low-density (typically 0.1 g/cm³ or less), porous materials that can be used in packaging, absorption, and insulation fields, have been intensely studied over the past twenty years and are typically produced using one of two processes, supercritical drying or freeze drying [4–9]. In the freeze drying process, the subject of this study, a hydrogel is frozen and ice is then removed via a sublimation process; the freezing of water largely dictates the morphology of the final aerogel, whose solid matter are concentrated within the grain boundaries of the ice [10,11]. By avoiding the melting of the ice, the inner structure collapse, due to capillary forces, is avoided [12]. It is not well understood how the rheological properties of the hydrogels, which clearly impact their viscoelastic properties, impact the final aerogel structure and properties. Understanding this relationship between rheology and product, for similar compositions, and its impact upon the product optimization loop, are the subjects of the present work [13–15]. Because of the polar nature of water and of smectite clays, freeze-dried aerogels are typically produced from polar polymers such as poly(vinyl alcohol) (PVOH), and ammonium alginate. Water allows for clay exfoliation, is environmentally desirable, and can be readily solubilized. Polymers of molecular weights that are readily soluble in a 2–10 wt % range are ideal for aerogel preparations.
FRACCION DE LÁMINAS EXTRÍSULAS A PARTIR DE PET OPACO RECICLADO.


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RESUMEN

El presente trabajo se engloba dentro de las acciones previstas en el proyecto “Revalorización de PET opaco reciclado en materiales innovadores (ReovalPET)” financiado por los fondos FEDER a través del programa INTERREG V A. En esta fase del estudio se pretende evaluar el efecto sobre el comportamiento de propagación lenta de grieta de la existencia de TiO₂ en un 2,4% en peso en PET reciclado proveniente de botellas. Para ello se ha aplicado la técnica del Trabajo Esencial de Fractura (EWF) en láminas obtenidas en extrusión-calentado a partir de dos tipos de PET reciclado proveniente de botellas: Transparentes (rPET-T), de origen español, y opacas (rPET-O) provenientes de Francia. Según los resultados obtenidos, la existencia de TiO₂ en la formulación no afecta el parámetro esencial del análisis (wₑ) relacionado con la energía necesaria para la generación de nuevas superficies libres, ni la resistencia de propagación de la misma, relacionada con el término no esencial (Γₑ).

PALABRAS CLAVE: EWF, reciclaje, rPET, PET opaco.

ABSTRACT

The present work is a part of the actions foreseen in the project “Upgrading of Opaque PET into innovative materials (ReovalPET)” financed by the FEDER funds through the INTERREG V A program. In this phase of the study, the effect of TiO₂ (2,4% w/w) in the slow crack propagating behaviour of recycled PET from bottle. To this end, the Essential Work of Fracture (EWF) technique has been applied on extrusion-selered sheets from two types of recycled PET from bottles: Transparent (rPET-T), of Spanish origin, and opaque (rPET-O) from France. According to the obtained results, the existence of TiO₂ in the formulation does not affect the essential parameter of the analysis (wₑ) related to the energy needed for the generation of new free surfaces, nor the propagation resistance of the same, related to the non-essential term (Γₑ).

KEYWORDS: EWF, recycling, rPET, opaque PET.

1. INTRODUCCIÓN

En los últimos años, han aparecido nuevas botellas de PET, totalmente opacas, generalmente blancas que se utilizan para el envasado de leche. Estas botellas contienen partículas de Dióxido de Titánio (TiO₂) con el objetivo de proteger su contenido frente a la radación UV y minimizar la permeación de oxígeno hacia el interior, evitando el deterioro del contenido. El reciclado de este PET opaco (r-PET-O) es difícilmente compatible con los procesos y los puntos de reciclaje de PET actuales, considerando que el principal uso de este material es la producción de fibras para el ámbito textil. La introducción de este PET en una proporción superior al 15% en peso darán lugar a problemas de procesabilidad (inestabilidad durante la producción del filamento) y el producto presentará pobres propiedades mecánicas, lo que potencialmente constituye un problema de futuro inmediato en las políticas de gestión de residuos (reciclaje) de este material [1, 2].

Según Taniguchi y Cakmak [3], las partículas de TiO₂ de tamaño submicrométrico, si bien presentan un claro efecto nucleante durante el enfriamiento o en el proceso de cristalización en frío, en la producción de filamento, durante la etapa de estanitemiento a temperaturas por encima de la Tg (≥ 90°C) el TiO₂ ejerce un efecto antinucleante, retrasando el proceso de cristalización inducida por deformación y disminuyendo el módulo de endurecimiento por lo que potencialmente generaría problemas de resonancia o hasta ruptura de la línea durante el procesado. Los autores lo atribuyen a que estas partículas, debido a la poca interacción con las cadenas poliméricas, retardan la formación de una red física cuyos nodos están formados por enredos y pequeños dominios cristalinos.
Application of the miniature small punch test for the mechanical characterization of UV-aged rPET

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RESUMEN

El objetivo del presente trabajo es el estudio de la influencia de la radiación ultravioleta (UV) en las propiedades mecánicas de polietileno tereftalato reciclado (rPET). Para ello, y mediante moldeo por inyección, se fabricaron tanto placas como probetas tipo halterio usando rPET y cuatro tipos de masterbatch con diferentes contenidos en pigmentos rojos, antioxidantes y absorbentes UV. Para llevar a cabo la comparación, además de caracterizar los materiales inmediatamente después de su fabricación, algunas de las probetas se expusieron a radiación UV durante 900 h y otras fueron sometidas a un tratamiento térmico con el fin de post-cristalizar el rPET de grado botella. La caracterización de los distintos materiales se llevó a cabo mediante ensayos de tracción, impacto Charpy, DSC y viscosidad intrínseca, excepto en el caso de las muestras irradiadas, cuyo pequeño tamaño hizo imposible el uso de ensayos mecánicos standard, por lo que se recurrió al uso del ensayo Small Punch (SPT). Los resultados obtenidos muestran que los dos parámetros que determinan la degradación del rPET, y en consecuencia sus propiedades mecánicas, son un secado adecuado y un nivel suficientemente bajo de contaminaciones de la materia prima antes del procesado. Además, mientras que el tipo de masterbatch utilizado en la fabricación no influye en la respuesta mecánica a tracción o a fractura, el tratamiento térmico sí lo hace, incrementando la rigidez y la resistencia, pero también disminuyendo la elongación en la rotura considerablemente. Por su parte, demostrada la aplicabilidad del ensayo SPT en la caracterización de este tipo de materiales, el uso de este tipo de ensayo permitió demostrar que la radiación ultravioleta no afecta a la respuesta mecánica de estos materiales, aunque visualmente las muestras irradiadas parecieran afectadas al mostrar una ligera decoloración.

PALABRAS CLAVE: Small Punch Test, PET reciclado, envejecimiento UV, post-cristalización.

ABSTRACT

The frame of this project is to study the influence of ultraviolet (UV) radiation exposure on the properties of recycled poly(ethylene terephthalate) (rPET). Four types of masterbatches were used which contained red pigments, antioxidants and UV absorbers. Dogbone samples and flat plates were injection moulded. Some samples were used as-moulded, some were subjected to UV radiation for 900 h and some samples received a thermal treatment in order to post-cristalize the bottle-grade rPET. The three sets of samples were analyzed by means of tensile tests, Charpy impact, DSC and intrinsic viscosity. However, the irradiated samples could not be tested with these methods due to their small size. The aim of this study is to evaluate the feasibility of small punch tests (SPT) in order to accurately characterize these small samples. It was found that the two parameters governing the rPET degradation and hence the mechanical properties were a proper drying and a sufficiently low level of contamination of the raw material before processing. Tensile test and Charpy impact results showed that the four types of masterbatch did not alter the mechanical properties of the rPET, whereas the thermal treatment increased stiffness and strength while the failure strain decreased drastically. Analogous to these results, SPTs on UV-aged samples showed no significant differences between irradiated and not irradiated samples. Moreover, the coefficients which relate the SPT parameters with the Young’s modulus and tensile strengths could be successfully determined for some selected materials. SPT was capable of detecting small differences for the irradiated samples due to the different types of masterbatches.

KEYWORDS: Small Punch Test, recycled PET, UV aging, post-cristalización.

1. INTRODUCTION

The recycling of PET at the end of its life cycle has become a major task in recent years for both industry and academia. This is because virgin PET is one of the most important engineering plastics due to its increasing use in the past two decades for many applications, especially for bottles and fibres. Recycling is the best option to economically reduce PET waste. The other driving force for PET recycling is that PET has a slow rate of natural decomposition because it is a non-degradable plastic in normal conditions. No known organism can consume its relatively large molecules and therefore complicated and expensive procedures are needed in order for PET to degrade biologically [1]. On the other hand, the price of virgin PET remains relatively stable. Therefore new and cheaper PET recycling technologies provide the industry with
Anales de Mecánica de la Fractura

TEXTO DE LAS COMUNICACIONES PRESENTADAS EN EL

XXXV ENCUENTRO DEL GRUPO ESPAÑOL DE FRACTURA

Número 35

Málaga
14, 15 y 16 de marzo de 2018
Aligeramiento de peso de PP/GF: materiales compuestos espumados para aplicaciones de automoción

RESUMEN

El aligeramiento de peso es una de las principales estrategias llevadas a cabo por los fabricantes de automóviles para reducir consumo de combustible y emisiones de gases de efecto invernadero. Debido a la creciente demanda de plásticos y materiales compuestos para aplicaciones de automoción, algunas tecnologías como la espumación han sido adoptadas para reducir su peso. El presente trabajo tiene como objetivo comparar la morfología y propiedades mecánicas de plásticos espumados obtenidos mediante dos tecnologías de espumación distintas: MuCell® y IQ Foam®. Placas macizas y espumadas de polipropileno reforzado con fibras de vidrio (PP/FRG) fueron obtenidas mediante moldes por inyección utilizando los procesos MuCell® y IQ Foam® en combinación con la tecnología de expansión de molde Core Back. La morfología de las placas espumadas resultantes se analizó mediante microscopía electrónica de barrido (MEB) y tomografía computarizada (CT), y las propiedades mecánicas fueron evaluadas a través de ensayos de tracción, flexión e impacto.

El análisis morfológico revela la existencia de una estructura micro/macromolecular espumado en las placas espumadas. Las propiedades mecánicas disminuyen gradualmente con la densidad aparente del material microporoso. La densidad aparente se reduce conforme el espesor de la placa, aunque la rigidez a flexión aumenta considerablemente. La nueva tecnología IQ Foam® permite la fabricación de piezas espumadas y ligera con propiedades resultantes comparables a las obtenidas mediante MuCell®, presentando otras ventajas en cuanto a coste, sencillez e independencia de máquina inyectora.

Lightweighting of PP/GF: foamed composites for automotive applications

ABSTRACT

Lightweight construction is one of the main strategies conducted by carmakers in order to reduce fuel consumption and greenhouse gas emissions. Since the demand of plastic and composite materials for automotive applications is continuously growing, lightweight approaches like foaming techniques are being introduced with the aim of decreasing their weight. The present work aims to compare the morphology and mechanical properties of plastic foams obtained by two different foaming technologies: MuCell® and IQ Foam®. Solid and foamed plates of glass fiber reinforced-polyporpropylene (PP/GF) were injection molded by using MuCell® and IQ Foam® processes combined with the complementary tool technology Core Back expansion molding. The morphology analysis of the obtained plates was carried out through Scanning Electron Microscopy (SEM) and Computed Tomography (CT) techniques, and the mechanical properties were assessed by means of tensile, flexural and impact tests.

The morphology analysis revealed the presence of solid skin-foamed core structure in the foamed samples. The mechanical properties decreased gradually with the apparent density of the microporous plates. By increasing the thickness of the part because of the expansion of the cavities, the apparent density decreased but the flexural stiffness was greatly enhanced. Foamed samples obtained by IQ Foam® technology exhibited lower cell density than that of the MuCell® ones, but consequently higher resistant area, and thus, slightly higher mechanical properties. The new IQ Foam® technology is able to producefoamed parts with properties compatible to that of the MuCell® process, offering additional benefits such as cost-effectiveness, easy to use and machine-independence.
CONGRESSOS
Participació en Congressos Internacionals
Kinetics of the thermal degradation of PLA/ABS blends. Effect of adding \( g \)-MAH compatibilizer

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A reactive extrusion-calendering process (REX) was used in order to manufacture square plates with a nominal thickness of 3 mm of poly(lactic acid) (PLA) and its blends with acrylonitrile-butadiene-styrene (ABS) with or without adding ABS grafted with maleic anhydride (MAH) as a compatibilizer agent. During processing, the properties of the melt were stabilized and enhanced by the addition of a styrene-acrylic multi-functional-epoxide oligomeric reactive agent (SAmFE) [1].

The onset decomposition temperatures of PLA–REX/ABS and PLA–REX/ABS/ABS–g–MAH were 303 and 330°C, respectively. Therefore, the onset temperature increased 27°C when adding the ABS–g–MAH compatibilizer. On the other hand, the final decomposition temperatures were 463 and 553°C, respectively (90°C higher when adding the compatibilizer).

The general analytical equation (GAE) [2] was used in order to evaluate the kinetic parameters of the thermal degradation of polymer blends. Various empirical and theoretical solid-state mechanisms were tested to elucidate the best kinetic model. In order to reach this goal, master plots were constructed by means of standardized conversion functions. Given that it is not always easy to visualize the best accordance between experimental and theoretical values of standardized conversion functions, a recently proposed index was determined to quantitatively discern the best mechanism. By doing that, it was possible to determine the right activation energy. The blend thermal degradation occurred in two steps. It was demonstrated that, for both blends, the best mechanism for the first step of the thermal degradation \( (x < 60\%) \) was \( R^2 \), with activation energies of \( 212 \pm 3 \) and \( 272 \pm 3 \) \( kJ/mol \), in the absence and presence of ABS–g–MAH, respectively. On the other hand, the best mechanism, also for both blends, for the second step of the thermal degradation \( (x > 70\%) \) was \( F_3 \), with activation energies of \( 95 \pm 2 \) and \( 128 \pm 2 \) \( kJ/mol \), in the absence and presence of ABS–g–MAH, respectively. Therefore, the addition of ABS–g–MAH led to higher activation energies, thus proving its protective effect against thermal degradation. Finally, SEM micrographs demonstrated the emulsifying/compatibilizing action exerted by the MAH contained in ABS–g–MAH compatibilizer, thus being responsible for a more thermally resistant blend.

REFERENCES
BOOK OF ABSTRACTS

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Crisan Popescu

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Book of abstracts of the 12th European Symposium on Thermal Analysis and Calorimetry (ESTAC12)

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Michele Bacciochi, University of Bologna, Italy
achieved, although the sensitivity of the mechanical characteristics and of the failure mode to the different curing conditions is here more pronounced than in the case of specimens without fiber reinforcement. As an example, specimens cured in water with dry densities higher than 600 kg/m³ exhibited a failure of the fiber reinforcement without separation, whereas those cured in air and in cellulose exhibited typical detachment failures. The motivation of studying these reinforcement arrangements and the structural performance of this composite material derives from potential applications in the civil engineering field. Indeed, in the authors’ opinion this composite material could be used for infill walls of buildings. In this way, it is expected that acceptable strength values may be obtained with relatively low densities, the latter assuring a lower self-weight of the structure as a whole, a good thermal insulating performance due to the internal void Capillarity in the microstructure, and a strong impermeability. Furthermore, it is also likely that the extrusion process of this material leads to limited construction costs of the structural and non-structural elements.

References

<809> Polymer/Clay Composite Aerogels
David Schiraldi (das14@case.edu), Case Western Reserve University, USA
Miguel Sánchez-Soto, Universitat Politècnica de Catalunya, Spain
Hong-Bing Chen, China Academy of Engineering Physics, China

Polymer/clay composite aerogels can be produced in aqueous solution by a simple and environmentally-friendly freeze drying process. The clay and polymer are excluded from the ice fronts which form during freezing, producing exfoliated clay in polymer nanocomposite lattices, which are preserved as the ice is removed by sublimation. The aerogel structures can be lamellar or cellular, depending on the freezing conditions, concentration of solids contained in the original aqueous mixture, and the molecular weight of the polymer used. The interaction between rheology, structure and mechanical properties will be discussed, including the composite model which resembles an average of open- and closed-cell foams. By judicious use of polymers (often biopolymers), radiation curing of the aerogels, and sometimes addition of phosphorous flame retardants, these foam-like materials can exhibit very low flammabilities, superior to the performance of traditional polymer foams.

167 | Cryogenic and high temperature behavior of metal foam matrix composites (MFMCs) under static and impact compression loads
Emanoil Lind (emanoil.lind@upt.ro), Politechnica University of Timisoara, Romania
Liviu Marcavina, Politehnica University of Timisoara, Romania
Petrica Lind, "Politehnica University of Timisoara" and "National Institute of Research for Electrochemistry and Condensed Matter," Romania
Jaroslav Kovacek, Slovak Academy of Sciences, Slovak Republic
Tomasz Sadowski, Lublin University of Technology, Poland
Adrian Bar, Politehnica University of Timisoara, Romania

Compared to fully dense solid metals, porous metallic foams are a new class of ultra-lightweight structural materials that are highly valued in recent years in many crucial engineering fields (such as aircraft, spacecraft, vehicle and buildings). All these applications are due to their excellent performances in energy absorbing and mechanical damping. Actually, owing to their wide range of applications, these composite materials are used under different loading conditions and at different temperatures [1]. Different lightweight and less expensive advanced composite structures capable of low and high temperature operation are also required for many future space exploration missions (and not only). Some typical cold and hot environmental temperatures, applicable for our solar system, are [2-5]: § the chilly night side of the Mercury (-180°C), § Moon Titan surface temperature (-180°C), § Moon Europa Icy surface temperature (-188°C to -143°C), § the rings of Saturn (+185°C), § the lowest temperature on Earth (Antarctic Plateau -89.2°C), § the highest surface temperature on Earth (Lut Desert-Iran 70.7°C), § Venus atmosphere (150°C between 40 and 48 km altitude and 325°C at 18 km altitude), § the day side of the Mercury (377°C), § the highest part of Terra Ithar (380°C). In practice, the effects of low and high temperatures, on the composites mechanical behavior, cannot be ignored because porous (foams) materials are very sensitive to temperature changes. Therefore, understanding the mechanical behavior of such cellular materials under extreme atmospheric conditions (from cryogenic to high temperatures) is very important and critical for exploring their suitability for constructing lightweight foam composite structures used in space, arctic and desert explorations. According to author’s knowledge, up to now there are no literature that discusses the compressive mechanical properties of metal foam matrix composites (MFMCs) at subzero and high temperatures.

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force-displacement curve is related to the increased internal friction loss that is the cause of the energy absorption absorbed by the composite member after the load is applied. The loop area where the composite member was damaged was in good agreement with the damage level. Artificial defects were manufactured on the surface of honeycomb sandwich composite panels. A NDE technique was proposed in order to detect defects by using terahertz waves and was discussed for tuning the practical use.

2- Paper ID: 4
Title: Kinetics of the thermal degradation of PLA/ABS blends: Effect of adding ABS-g-MAH compatibilizer
Authors: Félix Carrasco, Miguel Sánchez-Soto, Orlando O. Santan, Jonathan Cailloux and Maria L. Maspoch
Abstract: A reactive extrusion-calendering process (REX) was used in order to manufacture square plates with a nominal thickness of 3 mm of poly(lactic acid) (PLA) and its blends with acrylonitrile-butadiene-styrene (ABS) with or without adding ABS grafted with maleic anhydride (MAH) as a compatibilizer agent. The general analytical equation (GAE) was used in order to evaluate the kinetic parameters of the thermal degradation of polymer blends. Various empirical and theoretical solid-state mechanisms were tested to elucidate the best kinetic model. In order to reach this goal, the standardized conversion functions were used. Given that it was not always easy to visualize the best accordance between experimental and theoretical values of standardized conversion functions, a recently proposed index was determined to quantitatively discern the best mechanism. The blend thermal degradation occurred in two steps (R2 for the first step and F3 for the second one).

3- Paper ID: 8
Title: Accuracy of Real Space Cluster Expansion for Total Energies of Pd-rich PdX (X=Rh, Ru) alloys, based on Full-Potential KKR calculations for Perfect and Impurity Systems
Authors: Mitsuhiro Asato, Chang Liu, Nobuhsa Fujima, Toshiharu Hoshino, Ying Chen, and Tetsuo Mohri
Abstract: We study the accuracy and convergence of the real space cluster expansion (RSCE) for the total energies of the Pd-rich PdX (X=Ru, Rh) alloys, which are used to study the phase stability and phase equilibria of the Pd-rich PdX alloys. In the present RSCE, the X atoms of minor element are treated as impurities in Pd. The n-body interaction energies (IEs) among X impurities in Pd, being used in the expansion of the total energies of the Pd-rich PdX alloys, are determined uniquely and successively from the low body to high body, by the full-potential Korringa-Kohn-Rostoker (FPKRR) Green’s function method (FPKRR) for the perfect and impurity systems (Pd-host and Xn in Pd, n=1–4), combined with the generalized gradient approximation in the density functional theory. In the previous paper, we showed that the RSCE, in which the perturbed potentials due to the insertion of Xn impurities in Pd were redetermined self-consistently up to the 1st-nearest neighboring (nn) host atoms around Xn impurities, reproduce fairly well (the error of ~ 0.2mRy per atom) the FPKRR-band-calculation result of the ordered Pd3Rh alloy in L12 structure, but a little wrongly (the error of ~ 0.7mRy per atom) for the ordered Pd3Ru alloy in L12 structure. In the present paper, we show that this small RSCE
INFLUENCE OF FIBER ADDITION ON THE SOLUBILITY AND WATER VAPOR PERMEABILITY OF FLEXIBLE FILMS BASED ON ARROWROOT OBTAINED BY THERMOPLASTIC EXTRUSION

Amanda Dambrós Pereira¹, José Ignacio Velasco², Marcelo Antunes³, Lucia Helena Inocentini Mel³, Farayde M. Fakhouri¹.

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The arrowroot is a plant from Latin America and is indigenous to Venezuelan forests. The rhizomes range from 10 to 25 cm in size, are fusiform in shape, elongated and with small segments, separated by light bottlenecks with scales. The arrowroot can have up to 20% of starch, and 86% fibers. Therefore, the aim of this work was to use starch and arrowroot fiber for the production of flexible films by the thermoplastic extrusion process. Glycerol, 30% relative to the weight of starch, was used as plasticizer. Four samples were prepared, as follows: i) pure starch, ii) Starch + 0.5% fiber, iii) Starch + 1% fiber and iv) Starch + 1.5% fiber. The flexible films were obtained in two stages carried out in a monoroscan extruder (Figure 1). After extrusion the films were stored for 48 hours at 25 °C and 50% RH, and characterized for thickness, permeability to water vapor (PWV) and for solubility in water and acid. The films were off-white to the naked eye and the higher the fiber concentration was in the sample, the more resistant to the touch it was. The thicknesses were 0.2440; 0.3018; 0.6063 and 0.2760 mm respectively for samples i, ii, iii and iv. The PWV showed an increase with the increase in the fiber sample. Little difference was observed when 0.5% of fiber was added to the starch (range 12 to 13 g mm/m² d KPa). When more fiber was incorporated into the film, a considerable increase in the vapor permeability was observed, possibly due to possible rupture zones in the filmogenic matrix. The arrowroot starch films made from arrowroot fiber were 100% soluble in acid and showed a 30% solubility in water for pure starch film and 26.626% for film with 1.5% fiber.

Figure 1. Photographic image of extruded flexible films (a) arrowroot starch, (b) arrowroot starch with fibers (1.5%).

Keywords: Arrowroot, Extrusion, properties.
ANALYSIS BY GAS CHROMATOGRAPHY OF EDIBLE FILMS BASED ON GELATIN AND Melaleuca Alternifolia ESSENTIAL OIL

Farayde Matta Fakhouri¹, Rene P. Lima¹, Fernando F. Lima¹, Claudia A.L. Cardoso², Vitor A.S. Garcia¹, Cristina T. Filgueiras¹, Marcelo Antunes³ and José Ignacio Velasco³

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The packaging from renewable sources has gained prominence in the market due to interaction with the products, thus helping in conservation and longer shelf life. The Melaleuca Alternifolia essential oil is used in traditional medicine and known to have anti-inflammatory, antioxidant and antimicrobial properties. In this way, the objective of this work was to evaluate the incorporation and to identify the compounds by gas chromatography coupled to mass spectrometry in the essential oil of Melaleuca A. (OEM) and in gelatin-based films added with OEM. The films were produced by casting (10 g gelatin / 100 g film-forming solution) and the Melaleuca A. essential oil was incorporated under stirring at concentrations of 0, 5, 10, 15 and 20% in relation to the mass of macromolecule. After the incorporation of the essential oil, the films were homogeneous, with no brittle zones and no apparent cracks. The addition of the Melaleuca A. essential oil promoted a slight color change compared to the control sample. He main compounds identified by gas chromatography were α-pinene, 2-carene, α-terpinene, γ-terpinene, mentha-3,8-diene, Terpine-4-ol and α-terpineol, identified in the Melaleuca A. essential oil and in films with different concentrations of OEM. However, it was observed that the higher concentrations of the compounds were observed in films produced with the addition of 20% of OEM, being 2-carene (23.4%), γ-terpinene (51.2%), Terpine-4-ol (78.9%) and α-terpineol (9.2%), besides compounds such as aromadendrene, spathulenol, β-pinene and myrcene, which were only observed in the essential oil and in the film with addition of higher concentrations of OEM. In general, we can observe that the OEM is a source of bioactive molecules that present high antimicrobial and antioxidant capacity. In addition, the film with 20% of OEM addition can be considered a source of these compounds. Thus, edible films with addition of OEM can be considered an alternative as packaging to assist in the preservation of food products due to their antioxidant and antimicrobial properties.

Keywords: edible films, gelatin, bioactive composites.
Effect of an Ionomer on the Mechanical Performance of Flame Retardant ABS Formulations

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Abstract

Acrylonitrile butadiene styrene (ABS) is a widely used thermoplastic copolymer due to its desirable properties such as good mechanical performance (toughness, impact resistance, among others), ease of processability, chemical resistance, and low cost. Nevertheless, the major drawback of ABS is its inherent flammability characteristic which could restrict its use in a wide variety of applications where fire retardancy is required. Phosphorus flame retardants (PFRs) have been utilized in the last decade in ABS as a more environmentally friendly option compared with its halogenated counterparts. Nevertheless, one of the main drawbacks of incorporating PFRs into ABS is normally the deterioration of its mechanical performance. The use of an ionomer, as a compatibilizer, is the strategy proposed in the present work to reduce the negative effect of PFRs on ABS mechanical performance. In this study, two different PFR additives, selected regarding to high efficiency of flame retardant effect on ABS, and a commercial ionomer were incorporated into ABS by means of a melt blending process. Hence, the effect of adding a commercial ionomer on the ABS and ABS phosphorus flame retardant (PFR) formulations (ABS-PFR) was analyzed by means of different characterization techniques.

1. Introduction

Acrylonitrile butadiene styrene (ABS) copolymer is a thermoplastic produced by combining three monomers: acrylonitrile, butadiene, and styrene. The ratio between these monomers and the molecular structure of the ABS can be manipulated to produce goods with useful characteristics: ABS consists of two phases: a continuous phase of styrene-acrylonitrile (SAN) copolymer, and a dispersed phase of polybutadiene particles. Both phases promote the specific characteristics of the ABS polymer. SAN phase combines the easy processing of polystyrene with the stability and chemical durability of acrylonitrile. On the other hand, the incorporation of butadiene rubber into ABS copolymer promotes high impact strength characteristics. Beside these properties, the most important drawback of ABS is its inherent flammability behavior, like most of the styrene-based polymers [1, 2].

Many strategies are provided to improve the fire resistance of ABS, but due to environmental protections, halogen free PFRs are a preferable solution. However, the high content (20-30 wt.%) of PFR required to achieve flame retardancy leads to a deterioration of styrenes copolymers mechanical performance [3, 4, 5].

Compatibilizers are suitable candidates to improve blends miscibility and mechanical properties of flame retardant polymer formulations. Ionomers are a unique type of compatibilizers that have a small molar fraction (typically less than 10 mol%) of ionic groups covalently bonded to the polymer structure [6, 7]. The ionic cluster region of ionomers behaves as thermoreversible crosslinks and improves the toughness, melt viscosity, and adhesion properties of the copolymers [8-12].

In the present work, ABS and flame retardant ABS formulations were prepared and the effect of adding a commercial ionomer on the ABS and ABS phosphorus flame retardant (PFR) formulations (ABS-PFR) was analyzed. The main objective of this study was to analyze to effect of a commercial ionomer on the thermal stability and mechanical behaviour of ABS-PFR formulations.

2. Experimental Procedure

2.1. Materials

ABS pellets (ELIXTM 128 IG) was acquired from ELIX Polymers which have white to slightly yellowish color and the butadiene content of ABS is 26-28 %. PB with the commercial name BUNA CB 565 T, manufactured by LANXESS, was used.
Preparation of Nanocomposite Foams Based on Polysulfone and Carbon-Based Nanoparticles Using Wvips

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Abstract
Foams based on polysulfone (PSU) with graphene nanoplatelets (GnP) were prepared by water vapor induced phase separation (WVIPS). Prior to foaming, variable amounts of PSU (15, 20, 25 wt%) were dispersed in two different solvent, which are DMF and NMP, and intensively mixed. In addition, two different atmospheric conditions such as air and water applied on these samples. After the preparation of these foams, NMP was decided to use as a solvent in WVIPS in accordance with their morphological analysis. PSU foams were combined with different amount of GnP (1, 2, 5, 10 wt%) and these foams were characterized by using SEM, DSC and C-Therm Transient Plane Source (TPS) for indicating the relative density, GnP loadings amount and cellular structure effects on thermal properties of these foams.

1. Introduction
Foams are unique forms of porous and light materials in as much as they are the most preferable materials in many different areas such as automotive and aeronautical industries. These industries need lightweight and stiff materials because the velocity and security of these vehicles are related to their mechanical properties [1]. After technological developments resulted in a lightweight solution for foams, polymers have been substituted for metals and traditional composites due to their corrosion and creep resistance and specific mechanical properties. In addition, they can be used in tolerance parts easily and they can improve flame and smoke properties of materials [2, 3].

Polymer-based nanocomposites are used in many different areas such as aeronautics, electronics, automotive sector, etc. Carbon-based nanoparticles have been of interest due to their advanced properties such as high electrical and thermal conductivities, mechanical and other physical properties [4, 5]. The most important advantage of polymer foams is that they can be incorporated with very low concentrations of carbon-based nanoparticles such as graphene nanoplatelets (GnP) or carbon nanotubes (CNT). Thus, multifunctional polymer nanocomposite foams with low density could be obtained by using foam production methods such as extrusion, injection-moulding, solid state foaming using supercritical CO2 (scCO2) and water vapor-induced phase separation (WVIPS) techniques [3, 6]. Low-density and high-strength polymer nanocomposite foams can be generated by WVIPS. Polysulfone (PSU) is the preferred functional material to obtain polymer-based nanocomposite foams because of its transparency, good processability, high mechanical strength, flexibility and low creep, as well as excellent chemical and thermal stabilities [7-11]. Due to these advantages, it was desired to prepare PSU-based nanocomposite foams containing carbon-based nanoparticles using WVIPS. Hence, WVIPS was applied to obtain PSU-based nanocomposite foams with different amounts of carbon-based nanoparticles. Nanocomposite foams were evaluated with the different type of solutions, the amount of incorporated carbon-based nanoparticles and variations in density.

2. Experimental Procedure

2.1. Materials
PSU pellets (UDEL P-1700) were acquired from Udel Company. The density of PSU is 1.24 g/cm³, glass transition temperature is 185 °C and the purity
Participació en Congressos Nacionals
Kinetics of the thermal degradation of PLA and ABS blends

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Introduction

One of the most straightforward and economic ways for improving the thermal and mechanical properties of polymers is through melt-blending with other polymers. The replacement in the blend of part of PLA content by ABS could be a good approach to enhance PLA properties and widen its technological applications while keeping costs at a low level. In the present study, a new and directly industrial scalable approach is proposed for blending PLA and ABS.

The ever-increasing commercial importance of polymeric materials has entailed a continuous interest in their thermal stability. The kinetic modeling of the decomposition process plays a central role in many of those studies, being crucial for an accurate prediction of the materials behavior under different working conditions. A precise prediction requires knowledge of the so-called kinetic triplet, namely, the activation energy, the pre-exponential factor and the kinetic model [1]. It is well known that reaction mechanism of thermal degradation of macromolecules is very helpful in the field of the thermal stability of polymers.

The goal of this work aims at determining the thermal stability of PLA obtained by reactive extrusion (PLA-REX), ABS and PLA-REX/ABS blend. Moreover, various empirical and theoretical kinetic models were tested in order to elucidate the best mechanism describing the thermal degradation of these materials.

Experimental

A commercially available extrusion PLA grade (Ingeo 4032D®) was purchased from Natureworks. It contained a D-lactide content = 2 %, a melting temperature (Tm) of 167°C, Mn = 90 kDa and Mw = 181 kDa, respectively. A multifunctional epoxide reactive agent (referred to as SAmfE), namely Joncryl-ADR-4400F®, was kindly supplied by BASF with an epoxy equivalent weight of 485 g mol⁻¹ and a functionality of about 14. An ABS injection grade (Teruran GP-220), purchased from Stryolutions Group (Frankfurt am Main, Germany), was used with a melt flow index (MFI) of 19 ± 1 g/10 min (220°C, 10 kg). Fourier transform infrared spectroscopy (FTIR) gave the following weight composition: 61% of PS, 18% of AN and 21% of PBD.

Pellets of poly(lactic acid), obtained by reactive extrusion (PLA-REX), and ABS (with a weight content of 30% of ABS) were dry-mixed and subsequently dried at 80°C for 3 h. An extruder was used for the homogenization procedure of the blends. The screw speed was set to 45 rpm and the mean residence time was 4 min. The extrudates were water-cooled, pelletized (cut length = 5 mm) and placed in a convection oven at 90°C for 4 h in order to supply crystallized pellets. Finally, square plates of 100 mm x 100 mm x 3 mm were injected in an Engel Victory 110 injection moulding machine with a maximum clamping force of 110 KN. The selected injection flow rate of all specimens was 45 cm² s⁻¹.
Tailoring PLA/PA bioblends for 3D printing applications via the manufacturing of in situ microfibrillar composite filaments

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Introduction
The use of 3D printing for rapid prototyping has been viewed as a promising technology to produce components with complex geometries. However, the limited properties (e.g. lack of thermo-mechanical as well as mechanical resistance) of the usually used printed pure polymers (e.g. ABS, PLA, etc.) highlight several serious drawbacks which principally restrict the industrial implementation of 3D printed polymers.
The development of printable polymer composites using the fused deposition modelling technology greatly solve these issues due to a synergetic effect between the matrix and the dispersed phase properties [1]. In [2], our research group showed that the modification of the viscosity ratio between the PLA matrix and the PA dispersed phase through reactive extrusion yielded a finer and more homogeneous PA microstructure, therefore improving the final PLA mechanical properties at a much lower PA content. Kakooori et al. [3] reported that the in situ microfibrillation of PA domains during melt extrusion is equally a viable approach for the improvement of both the PLA melt elasticity and the PLA crystallization kinetics.
As a natural follow-up of our ongoing research on the manufacturing of bio-based in situ microfibrillar composites (MFCs), in this study, a reactive extrusion process using a multifunctional epoxy reactive agent was used to tailor the viscosity ratio between the PLA matrix and the PA reinforcing phase. The effect of these modified viscosity ratios on the final thermo-mechanical and rheological (e.g. melt strength) properties of the manufactured PLA-based MFC filaments are investigated and compared to unmodified PLA/PA blends.

Experimental
A commercially available extrusion PLA grade (Ingeo 4032D®) was purchased from Natureworks. It contained a D-lactide content=2%, a melting temperature (Tm) of 167 °C, Mw=90 kDa and Mw=181 kDa, respectively. A multifunctional epoxy reactive agent (referred to as SAMF®), namely Joncryl-ADG-4400®, was kindly supplied by BASF with an epoxy equivalent weight of 485 g mol⁻¹ and a functionality of about 14. A predominantly bio-based PA10.10, Zytel RS LC1000 BK385® (Dupont), was used as the dispersed phase in the production of the MFCs. It featured a Tm=200 °C, Mw=115 kDa and Mw=333 kDa.
Two different rheologically modified PLA (referred to as PLAex) were prepared using a co-rotating twin-screw extruder (screw diameter: 25 mm, L/D=36) and a nominal SAMF® content of 0.5 and 1.25 wt%, respectively. More details about PLAex manufacturing can be found elsewhere [4]. The PLA/PA MFCs were produced using a melt blending-hot stretching process. Prior to processing, all materials were dry-mixed and dried at 80°C for 4h in a Piovan hopper dryer (dew point = 40°C). The PLA/PA (70/30 wt%) blends were melt blended using the previously described co-rotating twin screw extruder. A N2 blanket was established in the feeding zone while vacuum was applied in the metering zone. The
Multi-scale surface analysis on polypropylene micro-textured injected samples using 3D non-contact techniques

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Introduction
Surface topography and surface micro and nano-features are used to impart special functional properties to polymers [1]. Characteristics such as self-cleaning, antimicrobial or hydrophobicity can be added to a certain polymer surface provided that the desired engraving is achieved.

Injection moulding is an appealing polymer manufacturing process that can be used for creating micro-topographies on top of a certain substrate. However, achieving a good replica requires detailed control of the injection process parameters (melt and mould temperature, holding pressure, injection speed etc.) that play an important role in terms of mould surface replication.

In this work the degree of mould surface replication at the micro scale level as a function of the injection parameters, has been studied. A three dimensional multi scale surface evaluation methodology, which allows analysing the features of the polymer replica at different scales, is proposed.

Experimental
A single square mould cavity with dimensions 100 x 100 x 3 mm (length x width x thickness) and equipped with a pressure sensor was used. The cavity surface was engraved with a leather texture through a chemical process. A high fluidity resin (Technovit 3040, Kulzer GmbH) was employed to obtain a high quality replica of the mould cavity and was used as reference surface. A polypropylene copolymer filled with 5% talc, HC TKC 2007 N from BASELL S.L (Tarragona, Spain), was used to inject the samples in an Engel Victory 110 injection moulding machine.

The influence of the injection parameters were studied through a two level factorial design of experiments (DOE) as shown in table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Low level</th>
<th>High level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melt temperature (°C)</td>
<td>200</td>
<td>270</td>
</tr>
<tr>
<td>Mould temperature (°C)</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>Injection speed (cm/s)</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>Holding pressure (bar)</td>
<td>400</td>
<td>600</td>
</tr>
</tbody>
</table>

Table 1. Injection parameters and its levels.

The polymer surface characterization was carried out using a non-contact chromatic white light sensor (CWL). A multi-scale surface analysis was made in order to detect differences in the topography, either at small scale (roughness) or large scale (form). Filters such as, S-filter, L-filter and F-Operator were used to limit surface information and remove components without interest [2]. The surface parameter studied was the arithmetical mean height, Sa.

Results and Discussion
To reach an optimal balance between surface information and sampling time, the optimal values of both sampling area (20 x 20 mm) and sampling frequency (50 mm⁻¹) were first determined.

From DOE analysis, the most relevant parameter which leads to high textured mould replicas was the holding pressure, following by both melt and mould temperatures. On the other hand, injection speed was found to not have a significant effect.
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CONGRESSOS NACIONALS: GEP

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Ponència Dr. J. Cailloux a la XV Edició del Grup Especialitzat de Polímers (GEP)
FRACTURA DE LÁMINAS EXTRUIDAS A PARTIR DE PET OPACO RECICLADO.

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RESUMEN

El presente trabajo se engloba dentro de las acciones previstas en el proyecto "Revalorización de PET opaco reciclado en materiales innovadores (RevallPET)" financiado por los fondos FEDER a través del programa INTERREG V A. En esta fase del estudio se pretende evaluar el efecto sobre el comportamiento de propagación de fisura de la existencia de TiO₂ en un 2,4 % en peso en PET reciclado proveniente de botellas. Para ello se ha aplicado la técnica del Trabajo Esencial de Fractura (ESF) en láminas obtenidas por extrusión-calendrado a partir de dos tipos de PET reciclado proveniente de botellas: Transparentes (rPET-T), de origen español, y opacos (rPET-O) provenientes de Francia. Según los resultados obtenidos, la existencia de TiO₂ en la formulación no afecta el parámetro esencial del análisis (ω) relacionado con la energía necesaria para la generación de nuevas superficies libres, ni la resistencia de propagación de la misma, relacionada con el término no esencial (ϕg).

PALABRAS CLAVE: EWF, reciclaje, rPET, PET opaco.

ABSTRACT

The present work is a part of the actions foreseen in the project "Upgrading of Opaque PET into innovative materials (RevallPET)" financed by the FEDER funds through the INTERREG V A program. In this phase of the study, the effect of TiO₂ (2.4 % w/w) in the slow crack propagating behaviour of recycled PET from bottle. To this end, the Essential Work of Fracture (EWF) technique has been applied on extrusion-calendered sheets from two types of recycled PET from bottles: Transparent (rPET-T), of Spanish origin, and opaque (rPET-O) from France. According to the obtained results, the existence of TiO₂ in the formulation does not affect the essential parameter of the analysis (ω) related to the energy needed for the generation of new free surfaces, nor the propagation resistance of the same, related to the non-essential term (ϕg).

KEYWORDS: EWF, recycling, rPET, opaque PET.

1. INTRODUCCIÓN

En los últimos años, han aparecido nuevas botellas de PET, totalmente opacas, generalmente blancas que se utilizan para el envasado de leche. Estas botellas contienen partículas de Dióxido de Titánio (TiO₂) con el objetivo de proteger su contenido frente a la radiación UV y minimizar la permeación de oxígeno hacia el interior, evitando el deterioro del contenido. El reciclado de este PET opaco (rPET-O) es difícilmente compatible con los procesos y los puntos de reciclaje de PET actuales, considerando que el principal uso de este material es la producción de fibras para el ámbito textil. La introducción de este PET en una proporción superior al 15% en peso dan lugar a problemas de procesabilidad (inestabilidad durante la producción del filamento) y el producto presenta pobres propiedades mecánicas, lo que potencialmente constituye un problema de futuro inmediato en las políticas de gestión de residuos (reciclaje) de este material [1, 2].

Según Taniguchi y Cakmak [3], las partículas de TiO₂ de tamaño submircrométrico, si bien presentan un claro efecto nucleante durante el enfriamiento o en el proceso de cristalización en frío, en la producción de filamento, durante la etapa de estiramiento a temperaturas por encima de la Tg (95 °C) el TiO₂ ejerce un efecto antinucleante, retrasando el proceso de cristalización inducido por deformación y disminuyendo el módulo de endurecimiento, por lo que potencialmente generaría problemas de resonancia o hasta ruptura de la línea durante el procesado. Los autores lo atribuyen a que estas partículas, debido a la poca interacción con las cadenas polieteréricas, retardan la formación de una red física cuyos nudos están formados por enredos y pequeños dominios cristalinos.
Application of the miniature small punch test for the mechanical characterization of UV-aged rPET

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RESUMEN

El objetivo del presente trabajo es el estudio de la influencia de la radiaición ultravioleta (UV) en las propiedades mecánicas de polietileno teretrolato reciclado (rPET). Para ello, y mediante moldeo por inyección, se fabricaron tanto placas como probetas tipo halterio usando rPET y cuatro tipos de masterbatch con diferentes contenidos en pigmentos rojos, antioxidantes y absorbentes UV. Para llevar a cabo la comparación, además de caracterizar los materiales inmediatamente después de su fabricación, algunas de las probetas se expusieron a radiaición UV durante 900 h y otras fueron sometidas a un tratamiento térmico con el fin de post-cristalizar el rPET de grado botella. La caracterización de los distintos materiales se llevó a cabo mediante ensayos de tracción, impacto Charpy, DSC y viscosidad intrínseca, excepto en el caso de las muestras irradiadas, cuyo pequeño tamaño hizo imposible el uso de ensayos mecánicos estándar, por lo que se recurrió al uso del ensayo Small Punch (SPT). Los resultados obtenidos muestran que los dos parámetros que determinan la degradación del rPET, y en consecuencia sus propiedades mecánicas, son un segundo adecuado y un nivel suficientemente bajo de contaminaciones de la materia prima antes del procesado. Además, mientras que el tipo de masterbatch utilizado en la fabricación no influye en la respuesta mecánica a tracción o a fractura, el tratamiento térmico sí lo hace, incrementando la rigidez y la resistencia, pero también disminuyendo la elongación en la rotura considerablemente. Por su parte, demostrada la aplicabilidad del ensayo SPT en la caracterización de este tipo de materiales, el uso de este tipo de ensayo permitió demostrar que la radiaición ultravioleta no afecta a la respuesta mecánica de estos materiales, aunque visualmente las muestras irradiadas parecieran afectadas al mostrar una ligera decoloración.

PALABRAS CLAVE: Small Punch Test, PET reciclado, envejecimiento UV, post-cristalización.

ABSTRACT

The frame of this project is to study the influence of ultraviolet (UV) radiation exposure on the properties of recycled poly(ethylene terephthalate) (rPET). Four types of masterbatches were used which contained red pigments, antioxidants and UV absorbers. Dogbone samples and flat plates were injection moulded. Some samples were used-as-moulded, some were subjected to UV radiation for 900 h and some samples received a thermal treatment in order to post-crystallize the bottle-grade rPET. The three sets of samples were analyzed by means of tensile tests, Charpy impact, DSC and intrinsic viscosity. However, the irradiated samples could not be tested with these methods due to their small size. The aim of this study is to evaluate the feasibility of small punch tests (SPT) in order to accurately characterize these small samples. It was found that the two parameters governing the rPET degradation and hence the mechanical properties were a proper drying and a sufficiently low level of contamination of the raw material before processing. Tensile test and Charpy impact results showed that the four types of masterbatch did not alter the mechanical properties of the rPET, whereas the thermal treatment increased stiffness and strength while the failure strain decreased drastically. Analogous to these results, SPTs on UV-aged samples showed no significant differences between irradiated and not irradiated samples. Moreover, the coefficients which relate the SPT parameters with the Young’s moduli and tensile strengths could be successfully determined for some selected materials. SPT was capable of detecting small differences for the irradiated samples due to the different types of masterbatches.

KEYWORDS: Small Punch Test, recycled PET, UV aging, post-crystallization.

1. INTRODUCTION

The recycling of PET at the end of its life cycle has become a major task in recent years for both industry and academia. This is because virgin PET is one of the most important engineering plastics due to its increasing use in the past two decades for many applications, especially for bottles and fibres. Recycling is the best option to economically reduce PET waste. The other driving force for PET recycling is that PET has a slow rate of natural decomposition because it is a non-degradable plastic in normal conditions. No known organism can consume its relatively large molecules and therefore complicated and expensive procedures are needed in order for PET to degrade biologically [1]. On the other hand, the price of virgin PET remains relatively stable. Therefore new and cheaper PET recycling technologies provide the industry with
Anales de Mecánica de la Fractura

TEXTO DE LAS COMUNICACIONES PRESENTADAS EN EL XXXV ENCUENTRO DEL GRUPO ESPAÑOL DE FRACTURA

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10. ABS-Based Flame Retardant Microcellular Foams for Automobile Applications

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Acrylonitrile–butadiene–styrene (ABS), owing to its high toughness and impact strength, chemical resistance and good processability, is an engineering thermoplastic vastly used in automobile parts, among others. Nevertheless, one of its drawbacks is its high flammability that limits its suitability in applications with fire retardant requirements. Thus, there is great interest in developing flame retardant formulations of ABS that maintain as much as possible its advantages of low cost, good processability, and high specific mechanical properties.

ABS is commonly used in the manufacture of automobile parts by means of the MuCell® microcellular injection molding process, with reported benefits of reduced cost and cycle time, improved dimensional stability, etc. The present work deals with the study of flame retardant ABS formulation and the effect of its weight reduction on the ABS fire and mechanical performance. Phosphorus-based flame retardant additives (PFR), aluminium diethylphosphate and ammonium polyphosphate, were used as a more environmentally friendly alternative compared with halogenated ones. A 25 wt% of such PFR system (1:1 proportion) was dispersed into the polymer melt by using a co-rotating twin-screw extruder. Subsequently, microcellular foamed ABS and ABS-PFR specimens with 10, 15 and 20% of weight reduction, were prepared by means of MuCell® injection technology.

Overall, it was noticed that the presence of the PFR led to foams with smaller cell size and higher cell density, which was related to a heterogeneous cell nucleation effect promoted by such particles. Furthermore, despite the fact that the presence of PFR particles decreased the impact strength of ABS, they enhanced its specific stiffness determined by dynamic mechanical-thermal analysis. Moreover, the heat-release rate measured by means of a cone calorimeter was notably reduced with the presence of the mentioned PFR system, due to a prominent condensed-phase mode-of-action of such additives on ABS.

Pilar Castejón, David Arencón, Marcelo Antunes, Vera Realinho, José Ignacio Velasco, Antonio B. Martínez

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Block and random copolymers of polypropylene–ethylene were selected to prepare porous membranes through the melt extrusion-annealing-uniaxial stretching technique (MEAUS), at a constant draw ratio. In some cases, these copolymers were blended with a homopolymer grade. The variation of temperature in the stages of extrusion, annealing and uniaxial strain was analysed. Several characterization techniques were employed to study this influence. The crystalline orientation was analysed by polarised infrared spectroscopy (FT-IR) and crystalline features were studied by Differential Scanning Calorimetry (DSC). The thermal stability of the membranes was checked through thermogravimetric analysis (TGA). Tensile tests were performed to ascertain the stiffness and ductility of the produced samples. The results were correlated with the porous morphology, global porosity and permeability to air. A close relationship was found between crystalline characteristics, porous morphology and the trends registered. An improved pore distribution along the membrane surface was found when copolymers were employed.
Polymers (ISSN 2073-4360; CODEN: POLYCK) is an international open access journal of polymer science published monthly online by MDPI. Polymers provides an interdisciplinary forum for publishing papers which advance the fields of (i) polymerization methods, (ii) theory, simulation, and modeling, (iii) understanding of new physical phenomena, (iv) advances in characterization techniques, and (v) harnessing of self-assembly and biological strategies for producing complex multifunctional structures.

Among other databases, Polymers is indexed by the Science Citation Index Expanded (Web of Science), Scopus, EI Compendex, CAS, Polymer Library, EBSCOhost and Current Contents - Physical, Chemical & Earth Sciences.

Polymers 2018: Design, Function and Application

Faculty of Biology
University of Barcelona
Spain
21 – 23 March 2018

Conference Chairs
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Frank Wiesbrock

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Conference Secretariat
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George Andrianou    Pablo Velázquez
Kristjana Xhuxhi    Sara Martinez
Lucia Russo         Sarai Rodríguez
Lynn Huang          Tian Li
Assessment of the conditions of the thermoplastic extrusion process in the bioactive and mechanical properties of flexible films based on starch and Brazilian pepper

Fakhouri, F.M. a,b; Freitas de Lima, F. a,b; Cardoso, C.A.L. c; Martelli, S.M.a; Antunes, M.b; Mel, L.H. I.d; Yamashita, F.b; Velasco, J.I.b

aFaculty of Engineering, Federal University of Grande Dourados, Dourados, MS, Brazil.
bCentre Català del Plàstic, Universitat Politècnica de Catalunya, Barcelona, Spain.
cResearch Center in Biodiversity, State University of Mato Grosso do Sul, MS, Brazil.
dFaculty of Chemical Engineering, State University of Campinas, SP, Brazil.

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Abstract
The objective of this work was to produce, through the thermoplastic extrusion process followed by blowing, manioc starch-based flexible films added with Brazilian pepper oil as an antioxidant and plasticizer agent, and verify if the bioactive compounds contained in the fresh pepper oil are present after the drying step of the thermoplastic extrusion. After analysis by gas chromatography-mass spectrometry volatiles compounds were identified in the films. Pepper oil also influenced the mechanical properties of the films. These results suggest that the temperatures used in the process, kept some of the existing compounds in the Brazilian pepper essential oil adhered to the packages.

Keywords: Thermoplastic extrusion, temperature, bioactive compounds.
CAPÍTOLS DE LLIBRE
CHAPTER 10

**Thermal, Electrical, Insulation and Fire Resistance Properties of Polysaccharide and Protein-based Aerogels**

MIGUEL SÁNCHEZ-SOTO,LIANG WANG,TOBIAS ABT,LUCÍA G. DE LA CRUZ AND DAVID A. SCHIRALDI

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10.1 Thermal and Insulation Properties

The need for efficient insulating materials has drastically increased in recent years due to worldwide efforts to decrease energy consumption. Around 25–40% of this energy is consumed in dwelling houses, of which 50–60% is required for heating and cooling of the buildings. Therefore, new efficient thermal insulation materials such as vacuum insulation panels and aerogels can drastically reduce this energy consumption. The outstanding thermal insulation properties of these materials are due to their reduced gas phase conductivity, which is dependent on vacuum and on pore sizes smaller than 100 nm.

Green Chemistry Series No. 58
Biobased Aerogels: Polysaccharide and Protein-based Materials
Edited by Sabu Thomas, Laly A. Pothen and Ruble Mavelli-Sam
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RECULL DE PREMSA
Zaragoza cierra con éxito la primera edición de los Innovation Workshops

ITAINNOVA, el Instituto Tecnológico de Aragón, ha acogido este año la Innovation Workshop Zaragoza la que ha sido un punto de encuentro entre empresas de la industria de los plásticos organizadas por el Centro Español de Plásticos, que también han pasado por Barcelona, Bilbao y Valencia.

La jornada ha contado con la participación de los miembros del consejo de ITAINNOVA, IRTA, EAE, Tecnología, Centre de Referència, Inteplast, AITEC, ITENNE, entre otros.

Así, los asistentes se han podido inspirar en las experiencias de Zalaz con ITAINNOVA para la aplicación de la tecnología 4.0 en el sector de los plásticos, de Cromagener con Geiger para desarrollar materiales compuestos con conductividad a fuego modificado para vehículos ferroviarios o de Mecotrons Carly con Eurecat para desarrollar un proceso de curado de tubos de plástico por ultrasonidos.

También se han expuesto los casos de éxito de ITAINNOVA con el Centre Català del Plàstic para la realización de muestras de aplicación de la innovación aplicada a los automóviles, de ApplyNano Solutions con Atlas para desarrollar nanopartículas reforzadas con nanomateriales de carbono para flujos de impregnación 3D y de ITEEN con BVK, entre otras empresas, sobre nanopartículas en materiales plásticos para aplicaciones destinadas a contacto sientitomario.

A continuación han tenido lugar las conferencias de Innovación, donde los asistentes, divididos en dos grupos, han preparado ideas para innovar en el sector de los plásticos, en ámbitos como los materiales, los procesos, el reciclaje, la impresión 3D o la industria 4.0 entre otros.

Una vez realizadas las Innovation Workshops, se pretende definir proyectos comunes de innovación que respondan a las necesidades de las empresas participantes y que sean beneficiosas.

Memòria D'activitats CCP 2018

10
El Innovation Workshop Bilbao, celebrado el 30 de enero en Galler-K4, fue un éxito de participación. Los asistentes propusieron ideas innovadoras con el objetivo de definir proyectos de investigación en común que respondan a las necesidades de las empresas del sector de los plásticos.

La jornada de innovación se abrió con la presentación de las centrales tecnológicas asociadas al Centro Español de Plásticos (Galler-K4, Certiko, Altea y (ITAINnova) para prologar con la presentación de casos de éxito de empresas que ya han apostado por innovar de la mano de estos centros.

Entre estas, se encuentra el proyecto de Alba Preída SLL Casting con Galler-K4 para desarrollar nuevos materiales con características físicas y térmicas similares a la cera de microfiltrados para su empleo como modelos de fundición.

También se presentó en Bilbao el proyecto de GESTAMP con Eurocall para la utilización de materiales composites en las carrocerías de los automóviles con el objetivo de reducir el peso de los vehículos.

Otro proyecto interesante fue el del Zubaia con ITAINNOVA de aplicación de la industria 4.0 en el sector del plástico: el del Científico del Plástico de exploración de tecnologías de microinmunización aplicadas al automóvil; el de Angiolino Testi con Altea para desarrollar nuevas soluciones en el sector del deporte y el de Quimicas Oro con ITENE para diseñar un nuevo ensayo que, entre otras mejoras, consiga reducir el material plástico utilizado en su fabricación.

Después de estas presentaciones se llevaron a cabo los talleres de innovación, donde los participantes divididos en dos grupos propusieron ideas para llevarlas en el sector de los plásticos, en ámbitos como las materialias, los procesos, la reciclaje, la impresión 3D o la industria 4.0 entre otros.

Después de pasar por Bilbao y Barcelona, los próximos Innovation Workshops tendrán lugar en Valencia (13 de febrero de 2018) y Zaragoza (1 de marzo de 2018) y las inscripciones a los dos ya se pueden realizar en la web del Centro Español de Plásticos.

**Categoría recientemente agregada:**
- Jornadas Técnicas
El Innovation Workshop Valencia concluye con éxito

15 de febrero de 2018

Las instalaciones de ITENE han acogido este 15 de febrero el Innovation Workshop Valencia, la tercera de las jornadas de innovación en el sector de los plásticos organizadas por el Centro Español de Plásticos.

La presentación de los centros tecnológicos asociados al Centro Español de Plástico (ITENE, Alios, Eurecat, Centre Catalá del Plàstic, ITAINNOVA y Galler-K4) ha dado el pistoletazo de salida a la jornada, que ha continuado con la presentación de casos de éxito que han colaborado con estos centros para innovar.

En esta ocasión, se han presentado nuevos casos de éxito, como los de BKV con ITENE, que han trabajado para mejorar las propiedades barrera de PLA para aplicaciones de inyección-soplado mediante nanotecnología.

Otra presentación inédita ha sido la empresa ApplyNano Solutions que ha contado con Alios para desarrollar termoplásticos reforzados con nanomateriales de carbono para hilos de impresión 3D.

También se ha estrenado en los innovation Workshops la empresa Biopolis, cuyo proyecto con Galler-K4 gira entorno de la síntesis de polihidroxiálcanolos a partir de subproductos del maíz.

Igualmente, se han expuesto los casos de éxito de SEAT con el Centre Català del Plàstic de exploración de tecnologías de microespumación aplicadas al automóvil; de Zalix con ITAINNOVA para la aplicación de la Industria 4.0 en el sector del plástico; y de Mecánicas Cairo con Eurecat para desarrollar un proceso de curado de tubos de plástico por ultrasonidos.
FORMACIONS
FORMACIÓ

CURSO DE TECNOLOGÍAS EN POLÍMEROS Y COMPUESTOS

**Data**: 08 de novembre de 2018

**Professorat**: Prof. M. Ll. Maspoch

**Lloc**: CENTA - Centro Nacional de Tecnologías Aeronáuticas.

Querétaro (Mèxic)

Fotografia: Prof. M. Ll. Maspoch amb alumnes de la formació realitzada a CENTA.
Participació en Jornades
Le invitamos a asistir gratuitamente a la jornada de innovación

**Innovation Workshop Valencia**
15 de febrero de 2018

**Plazas limitadas**
Parque Tecnológico C/ Albert Einstein, 1 Paterna (Valencia)

<table>
<thead>
<tr>
<th>8:30h - 9:00h</th>
<th>Recepción y registro de asistentes</th>
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</thead>
<tbody>
<tr>
<td>9:00h - 9:05h</td>
<td>Bienvenida a los asistentes</td>
</tr>
<tr>
<td>9:05h - 9:50h</td>
<td>Presentación de los Centros Tecnológicos asociados al Centro Español de Plásticos</td>
</tr>
<tr>
<td>9:50 - 10:05h</td>
<td>Mejora de propiedades barrera de PLA para aplicaciones de inyección-soplado mediante nanotecnología (BYK)</td>
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<tr>
<td>10:05 - 10:20h</td>
<td>Desarrollo de termoplásticos reforzados con nanomateriales de carbono para filamentos de impresión 3D (ApplyNano Solutions)</td>
</tr>
<tr>
<td>10:20h - 10:35h</td>
<td>Últimas tecnologías en conformado de tubos de plástico para la conducción de fluidos y gases (Mecánica Cairo)</td>
</tr>
<tr>
<td>10:35h - 10:50h</td>
<td>Aplicación de técnicas de microespumación para la reducción de peso y aumento de la rigidez, en piezas de interior del vehículo (Seat)</td>
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<tr>
<td>10:50h - 11:20h</td>
<td>Café - Networking</td>
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<tr>
<td>11:20h - 11:35h</td>
<td>Industria 4.0 aplicada a la fabricación de luminarias (Zalux)</td>
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<tr>
<td>11:35h - 11:50h</td>
<td>Synthesis of polyhydroxyalkanoates from maize manufacturing byproducts (Biopolis)</td>
</tr>
<tr>
<td>11:50h - 14:30h</td>
<td>Workshops de innovación</td>
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<td>14:30 - 15:30h</td>
<td>Comida de networking</td>
</tr>
<tr>
<td>15:30h - 16:30h</td>
<td>Conclusiones y formación de grupos de trabajo</td>
</tr>
</tbody>
</table>

**Inscripciones aquí**
Participació Jornades: INNOVATION WORKSHOP VALENCIA

15 de febrer de 2018

Presentació del Centre Català del Plàstic com a centre tecnològic associat al Centro Español del Plástico (CEP) per part del Dr. David Arencón exposant casos d’éxit amb col·laboració amb SEAT sobre l’exploració de tecnologies de microespumació aplicades a l’automòbil.
Es pot fer? Ho fem.

Al Centre Català del Plàstic hi ha una cosa que ens agraïm més que les respostes: les preguntes.

Per això som científics. Per això possem la nostra investigació al servei d’empreses i institucions per fer realitat els projectes innovadors. Per això també ens dediquem a la docència: per a compartir el nostre entusiasme amb noves generacions de ments creatives i curioses.

Per què? Com? Quan?
Innovar és trobar noves respostes a noves preguntes. Esperem les vostres.

INNNOVATION WORKSHOP VALENÇIA (15 febrer)
Participació Jornades: INNOVATION WORKSHOP ZARAGOZA

01 de març de 2018

Presentació del Centre Català del Plàstic com a centre tecnològic associat al Centro Español del Plástico (CEP) per part del Dr. David Arençon exposant casos d’èxit amb col·laboració amb SEAT sobre l’exploració de tecnologies de microespumació aplicades a l’automòbil.
PARTICIPACIÓ JORNADES

Fotografies: Presentació Dr. J. Gómez - Monterde sobre l’aplicació de tècniques de microespumació per la reducció de pes i augment de la rigidessa en peces de l’interior del cotxe.
SEMINARIS
Participació en Seminaris
SEMINARI MADRID:
Alternativa a los residuos plásticos.
Prof. M. Ll. Maspoch

https://youtu.be/2giI2deA4dQ
WEBINAR: “Composites de matriz polimérica espumados”

Dr. Miguel Sánchez Soto
PRESENTACIÓ TESIS BIN RAJA NAZRI, RAJA NAZRUL HAKIM.

Preparation and characterization of nanocomposites based on Polylactic Thermal, Rheological, mechanical and Fracture Properties.

Data: 01/06/2018
Hora: 15.00h

**Fotografies**: Cel·lebració Tesis Hakim a les instal·lacions del CCP.
Visites Científiques
VISITES CIENTÍFIQUES CCP

Fotografia de la visita guiada al Centre Català del Plàstic per part del Prof. José Ignacio Velasco i Prof. David Arencón al Vicerector Prof. Timothy Edward de la National University of Science and Technology of Moscow (MISIS) y al Subdirector de Asuntos Internacionales de la ESEIAAT Prof. Santiago Forcada el 14 de febrer de 2018.

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