FINAL PROGRAM

EUROTEC™ 2011
CONFERENCE

GRAN VIA VENUE / BARCELONA, SPAIN

14-15 NOVEMBER

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EQUIPLAST
Salón Internacional del Plástico y Caucho

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CONTENTS

	PAGE
Plenary Speakers	
Monday	2
Tuesday	3
Technical Sessions	
Monday Morning	4
Monday Afternoon	11
Tuesday Morning	22
Tuesday Afternoon	29
Interactive Poster Presentations	
Interactive Poster Presentation	38
Student Poster Presentation	42

PLENARY SPEAKERS

11.30-12.30 | MONDAY, 14 NOVEMBER | CENTRO DE CONVENCIONES 2 (CC2) – 2.33

Future Polymer Developments Driven by Global Sustainability Solutions

Frank Kuijpers, General Manager, Global Technology
SABIC Innovative Plastics

In view of global trends, it is critical for polymer producers to take responsibility for driving sustainability solutions in polymer development. On the one hand this involves improving the footprint of current polymers by optimizing the chain as well as looking for feedstock alternatives; on the other hand this also focuses on the utilization potential of polymers in society for sustainable solutions addressing global growth.

Frank Kuijpers is a graduate of the Technical University of Eindhoven in the Netherlands, where he received an MSC degree in biological off-gas treatment of SBR-plants. He joined DSM NV in the Netherlands, starting his career at the licensing subsidiary Stamicarbon as a process engineer for DSM's solution and high pressure processes. While at DSM, he held several positions in the engineering, manufacturing, business, and corporate staff departments. He then moved into executive management roles for R&D, Strategy Planning & Development and Large Capital Projects. Mr. Kuijpers then began working for SABIC. In 2009 he became General Manager of Global Technology at SABIC, a position he holds to this day.

14.00-15.00 | MONDAY, 14 NOVEMBER | CENTRO DE CONVENCIONES 2 (CC2) – 2.33

Plastics Injection Molding and Tool Making: Challenges in China and Future Visions

Kai Syrjälä, PhD, Director, Tooling and Molding Sourcing
Nokia

Many plastics companies now have suppliers in China owing to cost-performance advantages and high-volume capabilities, according to Dr. Syrjälä. In addition, because of China's large clusters of electronics companies and moldmakers, the country has been ramping up its automotive industry. Dr. Syrjälä's presentation will illustrate current working models and practices in tool and mold manufacturing in China, focusing on how to succeed, maintain progress, and manage quality. He will also discuss what can be expected in the future.

Dr. Syrjälä is Director, Tooling and Molding Sourcing, at Nokia, and has led R&D teams all over the world. He is also responsible for the development and maintenance of Nokia's global 3D-CAD systems and works with industrial designers on the company's key products. Nokia was one of the first companies to use full solid modeling to take plastics from "style to steel" with short lead times. Dr. Syrjälä has been active in implementing new business models between Nokia and its suppliers in China.

PLENARY SPEAKERS

11.30-12.30 | TUESDAY, 15 NOVEMBER | CENTRO DE CONVENCIONES 2 (CC2) – 2.33

Compounding 2021, or, How To Grow in a Decade of Uncertainty

Bernard Rzepka, COO/General Manager
A. Schulman EMEA

In the past ten years, the world has seen significant change, and change will continue at an even faster pace in the coming decade. With change comes risk—and opportunities for growth. This presentation provides an outlook on what may happen by 2021, and how, despite all the uncertainties, a company can still build a sustainable compounding business. The basis of success is a full understanding of the current and emerging trends to which the industry must adapt quickly. Several trends, plus examples regarding product innovation and a focus on diverging markets, are highlighted and discussed in detail.

Bernard Rzepka leads the EMEA activities of A. Schulman and is member of the global leadership team. In the past 20 years he has led R+D functions and businesses for A. Schulman; he began his plastics-industry career more than 25 years ago with ICI. A. Schulman successfully drives application development regionally and globally, and, in close cooperation with its customers, helps introduce new thermoplastic solutions in masterbatches, engineering plastics, speciality powders, and distribution.

14.00-15.00 | TUESDAY, 15 NOVEMBER | CENTRO DE CONVENCIONES 2 (CC2) – 2.33

When the Worlds Collide: Plastics & Applications

Ashish K. Kulkarni, Ph.D., Vice President, Technology & Innovation
Ticona Engineering Polymers

The pace of innovation in the world has significantly accelerated in the last few decades. Plastics and materials have contributed to innovation, more in some industries and less in others. One reason for the slower contribution of materials and plastics is the difference in how engineers in the plastics world and engineers in the applications world operate — the time scales and processes are different. These differences impede innovation. Ticona, with its extensive portfolio of high-performance polymers, is focusing on activities that deliver integrated solutions. The integrated solutions model enables the worlds of plastics and applications to "collide" effectively. In this presentation, Dr. Kulkarni will provide examples from Ticona and other thoughts and suggestions on how to drive innovation across the value chain.

Dr. Ashish K. Kulkarni is Vice President of Technology & Innovation at Ticona. Prior to joining Ticona, he was Vice President of Global Engineering, Building Systems for the Carrier Corp. from 2007 to 2010; and he was Vice President of Global Product Technology at American Standard Companies, Inc., from 2003 to 2007. From 1996 to 2003, Dr. Kulkarni held various managerial, process, and product engineering positions at General Electric Plastics. He received master's and doctoral degrees in chemical engineering from Rensselaer Polytechnic Institute, Troy, NY, USA, and a B.Tech in chemical engineering from Osmania University, India.

MORNING • MONDAY, 14 NOVEMBER

>> AUTOMOTIVE

Session Moderator: Jean Dauvergne | CENTRO DE CONVENCIONES 3 (CC3) - 3.12

9.00 261 **Automotive Sunroof Systems and Frames in Xiran® sma/abs**
Henri-Paul Benicou, Polyscope Polymers

Structural sunroof module components typically must meet a wide range of technical requirements, focusing on integrated functionality, safety, cost and weight reduction. Most glass-reinforced materials currently used for sunroof frames do not perfectly match the application needs of today and the future. Glass-reinforced SMA/ABS compounds, such as Polyscope's Xiran® SG grades, offer a unique combination of properties and cost effectiveness for the application. These include: high dimensional stability; very low warpage; good performance at low wall thicknesses; high creep resistance; excellent adhesion performance without surface treatment; low density; good chemical resistance to screw oils and lubricants; full recyclability.

9.30 305 **New High Heat Polycarbonates for Automotive Lighting Applications**
Mark van der Mee, SABIC Innovative Plastics

Trends in automotive lighting towards increased design freedom, weight reduction and lower system costs have resulted in an increased usage of thermoplastics. SABIC Innovative Plastics recently introduced its Lexan* XHT resin portfolio, a family of new transparent high heat polycarbonate copolymers. These resins can withstand elevated temperatures existing in close proximity to the light source and, as such, are suitable for usage in both metallized bezels and transparent lens applications. This paper will demonstrate the excellent metallization characteristics, weatherability and long-term color and property retention of these resins. Finally, other potential applications of Lexan* XHT resins will also be discussed.

10.00 133 **Expanded Injected PP System to Make 25% Lighter Esthetical Instrument Panel**
Alain Choquet, Visteon

By the year 2025, carbon emission levels will require for EU and China radical vehicle weight reductions. Plastics components can now be expanded during injection, keeping correct mechanical behaviour to design vehicle interiors. The paper presents instrument and door panel approaches and describes the importance of the PP material selection, the expansion system and the related component, injection press and tooling designs. The paper demonstrates how applications like visible instrument topper panels or side trimmings could be designed purposely to respect mechanical functions.

10.30 215 **Ultramid® Endure Stays Cool Even When It Is Hot**
Manoranjan Prusty, BASF SE

New Ultramid® Endure from BASF is the first of its kind PA66 based polymer which has excellent heat ageing resistance, welding strength after heat ageing and good processing properties. Ultramid® Endure can withstand continuous use over 3000 hours at 220°C and temperature peaks upto 240°C. The excellent heat ageing properties of Ultramid® Endure allows it to be used for applications such as resonator, charge air lines etc.

11.00 200 **Production of a Functional 3D-Plastic Pane**
Ralf-Urs Giesen, University of Kassel

In the last few years the use of plastics as a replacement of glass has increased many times over. Especially in the automotive industry more and more panorama roofs will be made out of polycarbonate in the near future. Advantages are a weight reduction and an improved processability in regards of the three-dimensionality. The integration of certain functions in these plastic panes is the next step towards manufacturing innovative plastic products. This research project is about the integration of an electrochromic system which is able to change its color and therefore its level of transparency by applying a voltage.

MORNING • MONDAY, 14 NOVEMBER

>> EXTRUSION-MODELISATION

Session Moderator: Olivier Crave | CENTRO DE CONVENCIONES 3 (CC3) - 3.15

9.00 118 **Computational Analysis and Design of Single Screw Extruders Having Screws of Complex Geometry with Mixing Elements**
John Vlachopoulos, Université d'Hamilton

The methodology is based on the Hele-Shaw flow approximation, which is the momentum equation describing spreading flow in two dimensions. The Hele-Shaw equations are applied in a layer-by-layer manner. The energy equation is solved simultaneously with the Hele-Shaw equations. This simplification enabled enormous reduction of effort for the creation of complex screw geometries and the computer time required for the simulation, over the fully 3D analysis, without compromising any important features. Screw design has been carried out by making changes in the screw geometry and examining pressure, velocity, temperature, strain rate, stress fields, particle tracing and flow animation.

9.30 193 **A Comprehensive Study of Low-Density Polyethylene in Capillary Flow**
Evan Mitsoulis, National Technical University of Athens

The capillary flow of a commercial LDPE melt was studied both experimentally and numerically. A full rheological characterization was carried out, and the experimental data were fitted both with a viscous model (Carreau-Yasuda) and a viscoelastic model (K-BKZ/PSM model). Particular emphasis is given to the pressure-dependence of viscosity, with a pressure-dependent coefficient p. It was found that only the viscoelastic simulations were capable of reproducing the experimental data well, while any viscous modeling always underestimates the pressures, especially at the higher apparent shear rates and L/D ratios.

10.00 361 **Three-Dimensional Finite Volume Method Simulation of the Melting Zone in a Single-screw Extruder**
Sebastien Grammel, Institut für Kunststoffverarbeitung

This paper presents a 3D numerical model to analyze the melting process in a single-screw extruder. The fundamental equations of fluid dynamics are solved using the Finite Volume Method. The software Fluent, distributed by ANSYS, Inc., was used for the numerical calculations. The computing domain is a helical-shaped screw channel. The solid bed is modeled as a fluid with a very high viscosity by adjusting the formulation of the Carreau model for temperatures below the melting temperature. The model predicts the melting length, pressure build-up and the velocity and temperature distribution within the channel.

10.30 197 **Computational Study of Velocity Field in Maddock Kneader with CFD Method**
Reza Darvishi, Kimia Javid Sepahan Co.

Viscoelastic flow in a Maddock Kneader in which the screw has rotating motions is simulated. Linear viscoelastic responses are considered using both the Maxwell model and the Boltzmann superposition model. Calculations are made first in a basic screw element and subsequently in Kneader screw modules where we consider leakage flows through the Leakage screw flights. Our study includes filled length variation in the crosshead screw extruder, screw characteristics of Kneader screw elements, and pressure profiles along the modular Kneader machine.

11.00 186 **Stress-induced Crystallization of a Metallocene High-density Polyethylene**
Savvas Hatzikiriakos, University of British Columbia

In this paper, the effects of shearing, uniaxial extension and temperature on the flow-induced crystallization of a high-density polyethylene (HDPE) are examined using rheometry. Extensional flow was found to be a stronger stimulus for polymer crystallization compared with that of simple shear. Generally, strain and strain rate were found to enhance crystallization in both simple shear and elongation at temperatures around the meting point. At temperatures well above the melting point, polymer crystallized under elongational flow, while there was no crystallization under simple shear flows.

MORNING • MONDAY, 14 NOVEMBER

>> PRODUCT DESIGN AND ENGINEERING

Session Moderator: David Howard | CENTRO DE CONVENCIONES 3 (CC3) - 3.16

9.00 246 **Synthesis of Polypyrrole/Polythiophene Copolymers in Supercritical Carbon Dioxide**
MGH Zaidi, University of Agriculture & Technology

Chemical oxidative copolymerizations of pyrrole with thiophene were carried out using ferric chloride initiator in supercritical carbon dioxide. Polymerizations were conducted with different concentration ratios of pyrrole to thiophene in a high-pressure batch reactor. The polymerization yield, which was up to 56.7 % in homopolymerizations, was found to decrease in copolymerizations at a 1:1 molar ratio of pyrrole to thiophene. The polymers were characterized by Uv-vis, FTIR, XRD spectra, elemental analysis, gel permeation chromatography, TG-DTA-DTG, four-probe electrical conductivity and atomic force microscopy.

9.30 244 **Mechanical and Thermal Properties of Supercritical Carbon Dioxide Processed Epoxy Silicone Blends**
SK Joshi, Defense Research Development Organization

Mechanical and thermal properties of epoxy have been modified through blending of diglycidylether of bisphenol A (0.1 mol) with polydimethylsiloxane (PDMS) at concentration ranging 1.0 to 3.0 phr of resin at 1400 psi and 90±10C for 1 hr in supercritical carbon dioxide, followed by curing with triethylene tetramine (10 phr) at 40±10C. The formation of synthesized epoxy silicone blends (ESBs) has been ascertained through UV-vis, FT-IR, XRD spectra and microscopy. With PDMS concentration, the compressive, tensile strength, Rockwell hardness (R scale), fringe values and crystallinity of ESBs were decreased with simultaneous increase in their impact strength, resistance against wear and thermal stability.

10.00 182 **Viscoelastic Characterization of Sport Curfaces and its Relation with Force Reduction Measurements**
Briatico Vangosa, Ing Chimica , Politecnico Milano

In this study the effect of sample thickness and viscoelastic dynamic properties of the material on force reduction measurement of sport surfaces is discussed. The study was carried out by means of lab tests with an artificial athlete apparatus and by dynamic-mechanical analysis. Seven different sport surfaces were tested and compared with other polymeric materials with a wide range of mechanical behaviours. The results show a marked effect of sample thickness on force reduction measurements, especially in the range of thickness commonly employed in running tracks. A correlation between asymptotic, high-thickness, response and intrinsic properties of the material was found.

10.30 209 **3-D Computer Simulation in Micro- and Nano-molding**
Hiroshi Ito, Yamagata University

3-dimensional FEM simulation was performed to clarify the mechanism on surface replication in micro-injection molding and thermal nano-imprinting. Especially, the filling behavior into micro- and nano-surface features was discussed in comparison with the experimental results. The simulation results and the experimental results of injection molding reveal the possibility of the generation of air traps in the filling stage, and it is considered that those air traps have a strong relation to replication shape and replication rate. The simulation results of thermal imprinting clarified the penetration behavior of polymer melts into nano-surface features in thermal imprinting.

11.00 131 **Study on Rapid Manufacturing Training Needs in the European Context**
Zaida Ortega, Universidad de Las Palmas de Gran Canaria

Rapid Manufacturing, as one of the most important emerging technologies, has a high potential as part of European industry, with a clear role in manufacturing process and economy. In this context, seven EU partners (KTRM project) have proposed an e-learning program on these technologies, to increase its knowledge and use, with the aim of improving competitiveness in companies. Results on surveys prepared in this project with the aim of establishing the actual situation in Europe in this field and filled in by companies and training centres are presented in this communication, providing an overview of RM general knowledge and use.

MORNING • MONDAY, 14 NOVEMBER

11:30 102 **Multi-objective Optimization Strategy For The Design Of Injection Mold Cooling System**
Ronan Le Goff, Pôle Européen de Plasturgie

The manufacturing of thermoplastics parts needs a cooling phase to give the shape to the part. In injection molding, cooling can represent more than 70% of the cycle time. This is the reason why cooling channels have to be designed with great care in order to meet quality with efficiency requirements. In this paper, we propose a methodology to optimize the geometry parameters and coolant temperatures of the channels based on the use of modeFRONTIER® software combined with the injection molding simulation software MOLDFLOW®. Multi-objective optimisation will be carried out with criterions based on quality and cycle time minimization.

>>THERMOFORMING:THIN GAUGE

Session Moderators: Marek Nikforov & Reinhold Plot | CENTRO DE CONVENCIONES 3 (CC3) - 3.14

9.30 **High-Output Thermoforming for Food Packaging**
Thomas Reinhardt, Marbach

What can today's technology do, what are the limits, and what is the outlook for tomorrow? After the machine, the tooling has the most important role. Technology changes drive the success of thermoformed packaging worldwide. The presentation gives a short history of thin-gauge thermoforming and an overview of today's state of the art. It reveals the advantages and the limits of thermoformed packaging and what challenges may come. The three-part presentation will discuss: 1) Materials to work with (thin gauging, alternative materials, functionalities in/of the material, etc.); 2) Technologies to work with (multidimensional plug motion, airflow control, tool vision.etc.) and 3) Functionalities of packaging (tamper-evident, barrier functions, in-mould-decoration, pre-printed packaging. etc.).

10.00 **Creating Value Instead of Wasting It**
Paul Scheers and Marek Nikiforov, Reynolds Food Packaging and GN Thermoforming Equipment

Retailers and the food industry are aiming (are being forced to aim, by regulators and governments!) to reduce their impact in terms of utilisation of resources and energy, and in terms of greenhouse-gas emissions. So the converting industry—the plastics industry—must look for solutions to make that happen. Climate change and sustainable development are among the biggest issues facing society and industry today. It is therefore increasingly important for consumers and producers to reduce the environmental impacts and resource utilisation of products and services through their whole lifecycles. Therefore packaging ought to be designed to satisfy technical, consumer and customer needs in a way that minimises its environmental and resource impact and maximises the possibility of recovery. Creating more value with fewer resources = reducing waste. So the focus should be producing value, not waste. We have interviewed many companies in the thermoforming industry across many European countries. We share here how the concepts of raw material and energy usage and waste generation are viewed today. We take a critical look at these views in today's environment of sustainability and in light of the 4R-concept: REDUCE, REUSE, RECYCLE and RECOVER. We believe that our industry has great potential to create and increase value by reducing waste.

10.30 **The Next Dimension in Thermoforming Machinery**
Alexander Donabauer Kiefel

Highly innovative pressure-forming machines set new standards in the efficient mass production of packaging parts: optimised dimensions coupled with maximum productivity and cost-efficiency. This presentation highlights a completely new approach to machine design for a new generation of thermoforming machines with a remarkable reduction of component production costs. It has been put into practice thanks to energy recovery and therewith low energy consumption, high operating speed, reduced material consumption through optimum utilization of the forming area, and a revolutionary film-conveying system. The presentation also includes standards on innovative SW tools; intuitive navigation; carefully thought-out diagnostic features; simulation of initial start-up and extra software features designed to benefit the user, including simpler operation, smooth functioning of mechanical components, and increased availability of the machine.

MORNING • MONDAY, 14 NOVEMBER

11.00 **Barrier Plastic Packaging as a Sustainable Alternative to Glass**
Xavi Franco, EDV Packaging

Thermoformed barrier containers are a winning solution for preserved, shelf-stable foods. Development of high-performance plastic materials and the reduced environmental impact of thermoformed plastics are both key success factors for barrier plastics versus glass for packaging. This presentation compares thermoformed barrier plastics versus glass: advantages, limitations, environmental impact, costs and evolution of both packaging materials in the market for packaged foods. The presentation also seeks to encourage collaboration between different sector actors so that the plastics industry can better compete versus the more consolidated glass and metal can industry.

>>ENGINEERING PROPERTIES AND STRUCTURE
Nanocomposites 1: Nanoclays

Session Moderator: Petra Pötschke | CENTRO DE CONVENCIONES 3 (CC3) - 3.11

9.00 120 **Nanocomposites Formed from Organoclays and Ethylene-based Ionomers**
Donald Paul, University of Texas at Austin

Our laboratory has been exploring which polymers are able to interact effectively with organoclays and which are not; the goals of this program are to develop an understanding of the organoclay-polymer interaction and where are the opportunities for this technology. This presentation will focus on recent work in our laboratory on the structure and properties of nanocomposites formed from ionomers made by neutralizing ethylene-methacrylic acid copolymers (of the Surlyn® type). The effects of cation type (sodium or potassium), degree of neutralization, and polymer melt index on the degree of exfoliation of the clay and the nanocomposite properties will be explored.

10.00 300 **Potential of Nano-Scale Filler for On-Line Paintable Polyphenylene Ether/Polyamide Blends**
Amo Hagenaars, SABIC IP

Blends of polyphenylene ether and polyamide are excellently suited for automotive exterior body panel applications because of their optimal balance of mechanical and thermal properties. The addition of low amounts of nano-size fillers leads to improved dimensional stability, which can be obtained with conventional fillers only at much higher loadings, thus providing a weight-savings advantage. For on-line painting purposes, the required electrical conductivity can be achieved by the use of carbon nanotubes (CNTs), where an adequate percolation limit is obtained at lower concentrations when compared to carbon black, while mechanical properties are not negatively influenced.

10.30 150 **The Effects of Nanofillers and Reinforcements on the Properties of Multi-scalar Multifunctional Rigid Polyurethane Foams**
Alvaro Cano, Centre Català del Plàstic

In the present work polyurethane foams containing fibrous reinforcements of polyethylene and steel, and variable concentrations of nano-sized clay, were prepared and studied, with the objective of developing new multi-scalar rigid foams with functional characteristics. The addition of clay favoured foaming due to a cell nucleation effect and contributed to the modification of the cellular structure, resulting in foams with lower elastic moduli and collapse stresses than the unfilled ones. The incorporation of the fibrous reinforcements led to foams with lower stiffnesses and compressive strengths, independent of their composition and properties.

11.00 128 **Polyurethane Foam Nanocomposites: Relationship Between Mechanical Properties And Filler-matrix Chemical Interaction**
Sergio Estravis, Cellular Materials Laboratory (CellMat), Condensed Matter Physics Department, University of Valladolid

Nanofillers are added to rigid PU foams to improve mechanical properties, but they do not always result in the desired effects. Poor dispersion of the fillers is usually accepted as a possible explanation, but chemical interaction between matrix and fillers could result in a reduction in final properties. In this study a variety of polyurethane rigid foams were produced and characterized. Different types of fillers and dispersion techniques were used. The experimental results suggest that chemical interaction between fillers and matrix plays an important role in this type of system.

MORNING • MONDAY, 14 NOVEMBER

>>ENGINEERING PROPERTIES AND STRUCTURE
Fracture and Failure

Session Moderator: Marilyn Minus | CENTRO DE CONVENCIONES 3 (CC3) - 3.13

9.00 **Keynote: Brian Landes**
Deformation Mechanisms of Polyolefin Film: The Types, Sequence, and Magnitude of Events That Lead To Failure

10.00 190 **Lifetime Prediction in Engineering Plastics – Limitations of short-term test extrapolations**
Kalyan Sehanobish, The Dow Chemical Company

Using short-term tests to predict future outcomes of any long-term process is common in extrapolation techniques in science, social science and engineering. However, in every process it is important to ascertain some sort of criterion before extrapolation techniques are employed. The criteria for predicting the lifetime of an engineering plastic for a specific application must include the requirements of the test to (a) reproduce the mechanisms of field failures and (b) have a technically sound procedure for extrapolation of a the relatively short test data. We will propose a quantitative modeling approach as an alternative to "empirical" extrapolation.

10.30 350 **Consideration of Weld Line Strength in the Simulation of Short Fiber Reinforced Thermoplastics**
Klaus Kuesters, Institute of Plastics Processing at RWTH Aachen University (IKV)

Weld lines are formed during injection molding when two flow fronts meet. They are often not avoidable in complex technical parts. Their presence reduces mechanical strength, especially in high-performance short fiber reinforced materials. Evaluating the load of highly stressed parts requires accurate knowledge of the interrelationship between the type of weld line, its morphological structure and the resulting mechanical properties. This paper attempts to develop a simulation method that allows the mechanical properties of weld lines to be considered precisely in part design.

11.00 234 **Use Of Digital Image Correlation and Inverse Modeling to Determine Residual Stress in Axisymmetric Polymer Components**
Frode Grytten, SINTEF Materials and Chemistry

This paper presents a new method to determine residual stress profiles in cables and other axisymmetric objects using digital image correlation and inverse modeling. Digital image correlation was used to determine full-field displacements resulting from cutting a slit in a disk made from cable insulation. These displacements were compared to predicted displacements in a finite element analysis of the cutting. Differences between nodal displacements and the corresponding measured displacements were used to construct a cost function, which was iteratively minimized by changing the residual stress field used as initial condition in the finite element simulation.

>>BIOPOLYMERS

Session Moderator: Jose Lagaron | CENTRO DE CONVENCIONES 3 (CC3) - 3.17

9.00 67 **Carbon Footprint Reduction with Renewable Based High Performance TPU**
Jesus Santamaria, Merquinsa

Merquinsa will quantify and compare greenhouse gas (GHG) emissions to validate that producing TPU parts from bio-based products is more environmentally friendly with hard science. The quantification of GHG emissions associated with the production of a product is commonly referred to as the "carbon-footprint". PAS 2050 is a method prepared by the British Standards agency for assessing GHG emissions throughout a product's lifecycle. The lifecycle is defined as beginning with raw material manufacture, either from agricultural or petrochemical inputs, through to delivery at a customer's facility. Merquinsa will present the latest results for its ECO-TPU range, based on different renewable raw materials.

MORNING • MONDAY, 14 NOVEMBER

9.30 86 **Latent Acid Catalysts for Thermoset Process Control in Advanced Composites**
Graham Murray, Bac2 Conductive Composites

Bac2 Ltd has developed a storage-stable BMC material, incorporating a latent acid catalyst for the compression moulding of advanced composite bipolar plates, key components of fuel cell stacks. The latent acid catalyst technology is used to control the reactivity of phenolic resins and furan bio-resins produced from agricultural waste. The special feature of the latent acid catalysts is the use of a thermally unstable base, hydroxylamine. On heating above 117◦C, decomposition of hydroxylamine rapidly releases the acid catalyst to begin the polymerisation. The latent catalyst has enabled the development of storage-stable phenolic and bio-resin based BMC and SMC.

10.00 119 **New and Improved Screw Technology for Processing NatureWorks INGEO™**
Timothy Womer, TWWomer & Associates, LLC

Since the early 1990s, enormous improvements have been achieved in the processability of INGEO™ bioplastic resins. In the early days, when the resin was being manufactured at a pilot plant, processing INGEO was very difficult. Today, natural additives are being used to improve processability. Several new lubricant additive packages were tested to determine which produced the best performance and process improvements. The process data was used to quantify the processability of the various additive packages. The data was compared to the internal pressure data that was collected to analyze the process.

10.30 124 **Development of Starch Biobased and Biodegradable Plastics for Use in Trays for Food-Packaging**
Alberto Lopez-Gil, CellMat Laboratory. Condensed Matter Physics Department

This research work develops new methods to produce biodegradable starch-based trays for food-packaging applications. This biopolymer presents several drawbacks, like poor mechanical properties, strong hydrophilicity and very high density. In order to overcome these drawbacks, three research lines have been set up: blending starch with natural fibers, the use of hydrophobic coatings that provide a barrier effect to the absorption of water, and testing the foamability of these materials with a new technique known as microwave-assisted moulding . Finally, an economic study has been carried out to prove the feasibility of introducing this biomaterial in the food-packaging market.

11.00 138 **Development of Modified Polylactide (PLA)**
Hiroaki Kishimoto, Kao Corporation

In this report, modified polylactide (PLA) resins have been developed and based on "Technology of Nano-Modification for Polymer", such as control of softening and of crystallization at the nano-scale. Two types of modified PLA have been developed—one clear and soft for extrusion molding, and the other a high-moldability PLA for injection molding. These PLAs have been used as alternatives to PP and ABS in stationery, packaging, convenience goods, electrical appliances and so on. Performances and technologies will be presented.

11.30 140 **2,5-furandicarboxylic Acid (FDCA); A Versatile Building Block For A Very Interesting Class Of Polyesters**
Matheus Dam, Avantium Chemicals BV

By applying its advanced high-throughput R&D technology, Avantium (www.avantium.com) is developing next-generation bioplastics based on furandicarboxylic acid (FDCA), called "YXY building blocks", which can be produced on the basis of sugars and other, non-food, carbohydrates. Polyesters are an important group of plastic materials. Avantium aims to replace oil-based polyesters (such as PET) with furanic polyesters (such as PEF) in a wide range of applications including bottles and carpets. In this paper, new results on the physical and chemical characteristics of furan-based polyesters are discussed, as well as processability and behavior in films and bottles.

AFTERNOON • MONDAY, 14 NOVEMBER

>> AUTOMOTIVE

Session Moderator: Jean Dauvergne | CENTRO DE CONVENCIONES 3 (CC3) - 3.12

15.00 122 **Stages Moulding: A Novel Technology to Produce Plastic Parts**
Miguel Rodriguez-Perez, University of Valladolid

This paper presents a novel technology to produce plastic parts called "Stages Moulding". The patented technology allows producing plastic parts with complex shapes, from a wide variety of polymers, with excellent surface quality, reduced thermal and mechanical stresses and possibility to produce parts with reduced weights. This novel process uses much cheaper moulds than those used in injection moulding. The specific characteristics previously mentioned make this technology very promising for the production of parts with larger sizes and/or for the production of small series. The paper presents the main characteristics of this technology presenting some real examples of parts produced.

15.30 132 **Thin TPO Film Overmolding to Decorate Vehicle Interiors**
Alain Choquet, Visteon

Many vehicle manufacturers are aiming diversifying their car interiors with more daring colours and textures with the more limited amount of investments. For large interior parts, like instrument or door panels, painting technology was the current state of the art. The main paper objectives are to describe the advantages and the roadblocks regarding thin TPO foil overmolding alternative. The paper presents in one hand the new generation of TPO soft foils "ready for graining" and in a second hand the innovative tooling necessary to laminate the foil during the PP injection shot.

16.00 342 **Part and Mold Design Guidelines for the High Volume Compression Molding of Carbon Fiber Reinforced Epoxy**
Donald Lasell, Think Composites, L.L.C.

The objective of this paper is to discuss unique part and mold design requirements for high volume, cost competitive compression molding of carbon fiber reinforced epoxy (CF/E) uni-directional prepregs (UD), chopped fiberglass reinforced polyester sheet molding compound (SMC) designs will be used for comparison. In this paper, information that could be used as a design and processing guide for composites engineers involved with the development of high stiffness and strength CE/E for application in the transportation industry will be shared. After conducting considerable research into the documentation of compression molding design guidelines for use with highly reinforced epoxy preimpregnated materials.

16.30 181 **New Processes for Large Scale Automotive Production of Composite Applications**
Marcus Schuck, Jacob Plastics GmbH

In conventional manufacturing processes, composite structures are formed in multistage, costly process chains and joined in additional process steps (e.g. gluing or welding). In terms of process engineering, the biggest savings in mass production can be achieved by minimizing cycle time. Jacob has developed new processes, FIT-Hybrid (JEC Award 2011) and SpriForm which combine moulding, forming and joining processes of thermoplastic composites in a single, cost-effective, large scale process. The key benefit of the invention is, that in addition to the lightweight potential of composites, this process offers an extraordinary potential of lightweight due to the combination with structural design.

17.00 135 **Adhesion Between Polypropylene and Steel by Over Moulding**
Miguel Sanchez Soto, Centre Catala del Plastic

In this work a hybrid Polypropylene/steel car part (Traverse leg) was created by overmoulding. PP was modified with 10%wt. of PP-g-Ma coupling agent. Different surface treatments were applied to the steel determining its influence on adhesion. Best peel strength was reached when the steel was sanded. Etching and shot peened plates showed similar but lower levels of adhesion. In all cases the application of torch heating was necessary to create a thin layer of iron oxide strongly bonded to the steel and by reaction to the PP-g-Ma. To create adhesion a minimum steel temperature of 120°C was necessary.

AFTERNOON • MONDAY, 14 NOVEMBER

17.30 314 **Enhancing the Tiger Stripe Performance of Polypropylene Copolymers and Compounds**
Peter Neuteboom, SABIC T&I

Poly propylene copolymers are commonly used as the main ingredient in TPO automotive applications. High performance requirements are dictated by customers and end users. The challenge is to find the right balance in properties. Use of impact modifiers and fillers are widely used to increase the properties of compounds, however some properties like for instance tiger stripes can negatively be influenced by the impact modifier and or filler.This work will show pp-copolymers that have excellent tigerstripe performance on their own and also in compounds exhibit excellent TS performance without sacrificing other properties like flow and impact performance.

18.00 187 **Solutions with UV-Curing Paint Technology for Different Business Units**
Dagmar Ehmann, Peter-Lacke

UV-curing paint technology is known since many years e.g. in the field of wood application or in the area of plates and blanks. The new Dual-cure paint system of PETER-LACKE combines the advantages of the very fast drying and excellent scratch resistance of a UV-curing paint system with the 3-D painting ability and physical properties of a conventional thermal cured PU-paint system. Many colours and effects are possible in both UV paint systems and can be used on various plastics as well as on metal or glass.

18.30 188 **Coatings on Transparent Plastics for Automotive Applications**
Ulrike Schulz, Fraunhofer IOF

Transparent thermoplastic polymers hold an important position as materials for optics and automotive glazing. The advantages of plastics are significant weight reduction, high impact strength, moulding options and cost saving when mass-produced. However, soft plastic parts need to be protected by coatings. A presently well-established coating system for plastics is plasma ion-assisted deposition. A comprehensive understanding of complex interactions between the plasma and the different polymer materials is a key factor for the development of coating strategies. Some coatings on Polycarbonate and PMMA for automotive applications will be discussed for example.

>> EXTRUSION

Session Moderator: Vijay Boolani | CENTRO DE CONVENCIONES 3 (CC3) - 3.15

15.00 336 **Life Cycle Assessment of Metallocene Polyethylene in Heavy Duty Sacks**
Abdelhadi Sahnoune, ExxonMobil Chemical Company

The substitution of plastics for more traditional materials stems from their reliability and affordability. However, with the heightened awareness on sustainability, plastics from fossil sources are sometimes perceived to adversely impact the environment. A detailed life cycle assessment of heavy-duty bags made from metallocene polyethylene (mPE) has been completed. The results show that these bags have several positive attributes and in many instances may be a preferred alternative from a sustainability perspective. In fact, mPE bags are shown to consume significantly less energy and emit fewer greenhouse gases than paper-based alternatives. Additional environmental benefits will be discussed.

15.30 208 **Avoiding GIGO Pitfalls in Extrusion**
Jaime Gomez, K-Tron

The American phrase 'garbage in, garbage out' succinctly describes a problem often faced by plastics extrusion processors worldwide: no matter how well an extruder extrudes, its output will not be on-spec if the input blend is off-spec. Rightly, when formulation problems do arise, the on-line proportioning system draws initial troubleshooting focus. But the problem itself (or its underlying cause) may lie elsewhere, farther upstream. This paper systematically addresses the major process operations prior to extrusion (and beyond to include the material themselves) in an effort to identify and avoid the various pitfalls that may plague reliably accurate formulation.

AFTERNOON • MONDAY, 14 NOVEMBER

16.00 69 **Tilting Die, the Convincing New Solution to Centre an Annular Die**
Heinz Gross, Gross Kunststoff-Verfahrenstechnik

Annular dies are centred for the production of pipes, blown films or blow molded parts in the same way they were 30 years ago. The existing technical solutions are still very poor. Often, the operator has to climb into the line and adjust centring screws manually. Using a tilting joint solves the problem and enables an automatic centring of an annual die. It can even integrated into the closed-loop thickness control of a blown-film line. This allows, as an example, a fully automatic start-up of a blown film head.

16.30 146 **Reactive Extrusion of Poly(Lactic Acid) with Styrene-Acrylic-Glycidil Methacrylate**
Orlando Santana Pérez, Universitat Politècnica de Catalunya

This paper presents the rheological, thermal and mechanical properties of two grades of PLA modified by a glycidil methacrylate-based extender and branching agent. This modification could improve the melt strength and processability. In order to study the scaling-up of conditions (main key problem for industrial processing), the modifications have been made by two processes: a) internal mixer at laboratory scale and b) pilot plant scale (twin screw extrusion - continuous calender). Oscillatory rheological measurements have been considered the fastest parameter to assess the degree of change achieved (about 20 minutes was obtained).

17.00 359 **Optical Analysis of Extrudate Swelling of Polymer Melts**
Thomas Ottnad, Technische Universität München

Miniaturization and individualization are some of the ongoing trends in manufacturing in general and they also are influencing the plastics processing industry. To meet the upcoming challenges, a lot of research is being done in the field of micro-extrusion. This work investigates a method to identify the phenomenon of extrudate swelling of micro- extruded polypropylene using an optical analyzing method. Experimental data varying the pressure is presented using optical analysis. The results show the suitability of the method but reveal that some more experiments have to be done in order to formulate clear statements.

17.30 116 **Feed Enhancement Technology for Low Bulk Density Material into Co-rotating Twin-screw Compounding Extruders**
Paul Andersen, Coperion Corporation

Effectively feeding low bulk density material into a co-rotating twin-screw extruder has always been a challenge. However with the introduction of even finer particle size fillers (sub-micron in some cases) as well as new generations of polymer reactor resins, the issue has become even more problematic. Additionally as bulk density decreases, the materials tend to fluidize more easily. Fluidization lowers the "effective" bulk density even further and exacerbates feeding issues. This paper will review a new Feed Enhancement Technology (FET) that provides significant improvement for the introduction of fine particle / low bulk density materials into the extruder.

18.00 117 **Co-rotating Fully Intermeshing Twin-screw Compounding Extruders Technology Advancements for Improved Performance and Productivity**
Paul Andersen, Coperion Corporation

The co-rotating fully-intermeshing twin-screw extruder is the primary compounding production unit in the polymer as well as chemical and even food industry. While this equipment celebrated its 50th anniversary several years ago and might be considered a "mature" technology, it has not experienced a decline in new developments as might be expected, but rather a significant number of advancements continue to evolve. This presentation will highlight the main developments over the past 10 to 15 years. These will include advancement of high torque compounding concepts as well as use of increased rpm in conjunction with high torque for improved productivity.

AFTERNOON • MONDAY, 14 NOVEMBER

>>MEDICAL POLYMERS AND NANO-COMPOSITE STRUCTURES

Session Moderators: Austin Coffey and Len Czuba | CENTRO DE CONVENCIONES 3 (CC3) - 3.11

15.00 94 **Electrospun Nanofibrous Mats Based on PLLA and PCL Containing Tetracycline Hydrochloride as an Active Wound Dressing**
Payam Zahedi, University of Tehran

Electrospun nanofibrous mats made from poly(lactic acid) and poly(ε-caprolactone) containing tetracycline hydrochloride antibiotic as active wound dressings were prepared and their properties investigated. Samples of poly(lactic acid) and poly(ε-caprolactone) solution in chloroform/dimethylformamide (9/1) with 9, 12 and 15 (w/v)% containing 500 µg/ml drug were prepared. These nanofibrous samples were then investigated by predesigned tests such as scanning electron microscopy, water-uptake capacity, UV-Vis spectroscopy and antibacterial drug evaluations. The results showed that 15 (w/v)% poly (-aprolactone) samples with 500 µg/ml concentration tetracycline hydrochloride had a higher efficiency compared with other nanofibrous samples.

15.30 121 **Processing and Properties of Bioabsorbable PLLA-HA Composites**
Montgomery Shaw, University of Connecticut

Orthopedic procedures often require repair materials that can carry large loads without excessive deformation or failure. To this end, we designed composites using two biocompatible/biosorbable polymers, poly(L-lactic acid) (PLLA) and polycaprolactone (PCL). The latter was filled with nanoneedles of hydroxyapatite (HA), while the PLLA is used in long-fiber form. Theory advises that the HA nanoneedles must be of high aspect ratio and be aligned in the matrix to gain sufficient stiffness. We have explored several processing techniques for accomplishing this task, and have successfully made composites in the 8- to 10-GPa range. Variations of this structure will also be described.

16.00 143 **Mech Props of Lactide Based Scaffolds Filled with Inorganic Bioactive Particles**
Aitor Larranaga, University of the Basque

The mechanical properties of highly porous scaffolds have been investigated. Scaffolds of poly(L-lactide)(PLLA) and poly(L-lactide/ε-caprolactone)(PLCL) filled with 5, 10 and 15 vol% of Bioglass® and hydroxyapatite particles were prepared by a solvent casting/particulate leaching procedure. The thermal properties of the scaffolds were determined using differential scanning calorimetry (DSC) and thermo-gravimetric analysis (TGA), while the morphology was characterized by scanning electron microscopy (SEM). All scaffolds presented a highly porous structure and well-interconnected pores. Tensile test results revealed that the addition of bioactive particles increases the modulus while decreasing the relative elongation at break.

16.30 366 **The Production and Use of Supported Nano-Silver Particles in Polymer Systems**
Matthew Gande, BASF

Silver, a known antimicrobial agent, has found use in protecting a range of products against bacterial growth. The inherently large surface area of silver nanoparticles allows for a high release rate of silver ions to the environment, where they can be active against a wide range of microbes. We report a new method of producing silver nanoparticles using a plasma furnace. This process easily allows for the support of the nano-silver material on micron-sized inorganic particles. Silver formed in this manner is more easily dispersed in polymer systems, while maintaining antimicrobial activity against gram positive and negative bacteria.

17.00 139 **Effect of Physical Aging on Enthalpy Relaxation and Embrittlement of Elastomer TPE Biodegradable PLLA-PCL**
Jose-Ramon Sarasua, University of the Basque

In the design of new polymeric materials, long-term stability and durability are matters of considerable importance. It is known that during physical aging, volume contraction and densification of the sample occur, and therefore physical properties such as mechanical or crystallization behavior of amorphous polymers may be affected. In this work, the impact of physical aging on two biodegradable poly(L-lactide/ε-caprolactone) (PLCL) copolymers differing in their randomness character was studied. Their thermal behavior was evaluated by specific aging strategies using differential scanning calorimetry (DSC), while the effect of aging on mechanical properties was determined by tensile tests.

AFTERNOON • MONDAY, 14 NOVEMBER

17.30 235 **Key Issues in Microfabrication, Thermal Bonding and Surface Modification of Cyclic Olefin Copolymer**
C.Y. Yue, Singapore-MIT alliance

Cyclic olefin copolymers (COC) are commonly employed for making microfluidic devices. Several issues must be addressed before this can be realized. A reliable technique for micro-replicating COC is required. Good sealing and high bond strength between COC inter-layers without destroying channel integrity is necessary. The intrinsically hydrophobic surface has to be rendered hydrophilic to facilitate flow and electrophoretic separation. Here we report the production of high-fidelity microdevices by hot-embossing. Thermal seals with high bond strengths for bonding below the glass transition temperature, photografting using suitable hydrophilic monomers to give good surface wettability and hemocompatibility are outlined.

18.00 179 **Bisphenol-A Free Dental Polymer Composites**
K. Lizenboim BJM Laboratories Ltd.

Bisphenol-A (BPA) has caused concern as it is suspected to be an endocrine disrupter. Current polymeric dental materials are based on BPA derivatives, e.g. Bisphenol-A Diglycidylether Methacrylate (Bis-GMA) which may leach out unreacted monomers and its degradation products. This work focuses on BPA-free alternatives, preferably from natural resources, for potential use in dental polymers and composites. Experimental results indicated that BPA-free monomers from natural and synthetic sources can replace Bis-GMA without sacrificing physical and mechanical properties of the final dental polymeric adhesives and composites.

18.30 **TBD**
David Howard [Plenary EMPD]

>> PRODUCT DESIGN AND ENGINEERING

Session Moderator: Jim Griffing | CENTRO DE CONVENCIONES 3 (CC3) - 3.16

15.00 223 **Designing Lexan* Copolymers for Future Markets**
Andries van Zyl, SABIC IP

With the progression of technology, novel materials are needed to address specific design criteria of equipment manufacturers. The most common method to manipulate material performance is by either blending or an additive approach. Although relatively cost-effective and requiring low technological input, these methods are not always desired due to the potential non-permanence of the blend or additive constituents, or incompatibility. In this paper a copolycarbonate approach will be discussed to address specific consumer needs. More specifically, the tailoring of properties from a molecular perspective will be discussed; examples show how copolycarbonates can be used to capture novel markets.

15.30 313 **Lexan* Polycarbonate for Optical Applications**
Hans de Brouwer, SABIC Innovative Plastics

Lexan polycarbonate has excellent mechanical and optical properties, making it the material of choice for lighting applications like lenses, lightguides and bulbs but also for construction of roofing and greenhouses. With the advent of LED technology, the functional lifetime of lighting products has increased impressively. Plastics will age, though, under the influence of heat, light and time, causing reduced light transmission and color changes. In this paper, we indicate several key factors that determine the optical material performance and illustrate how optimization of these parameters during monomer and resin production leads to a enhancement of color and color stability.

16.00 347 **A Review of Long Fiber Thermoplastics (LFT) Composites Design**
Raj Mathur, PlastiComp, LLC

Long fiber thermoplastic (LFT) composite design studies often emphasize fiber content but are sketchy on fiber-orientation, fiber-matrix interface and mold design. In this paper we detail a comprehensive approach to designing with LFT materials. Specific examples are given. Carbon-fiber compounds were successfully substituted for die-cast magnesium parts by redesigning the metal part for injection molding. Tailored fiber architectures were achieved through strategic gate locations, as advised by Finite Element Analysis (FEA) and Mold Flow Analysis (MFA). Mechanical properties were enhanced through modified molding processes.

AFTERNOON • MONDAY, 14 NOVEMBER

16.30 330 **Thermoforming Ultem* Foam Sheet**
Emmanuel Boxus, SABIC Innovative Plastics

SABIC Innovative Plastics introduced PEI (polyetherimide) foam, a rigid foam with many properties of Ultem* resin, an amorphous thermoplastic PEI, with high thermal resistance, good FST (flame-smoke-toxicity) performance and broad chemical resistance. Among the application benefits of Ultem* foam (machinability, good bonding to composite skin materials, low moisture uptake), thermoformability is a unique characteristic. A specific technique utilizing matched metal tooling and a customized clamping system has been developed to (cost)effectively thermoform complex 3D-geometries out of foam. With the addition of an overmolded decorative layer, finished parts can be created with a significantly reduced cycle time versus existing techniques.

17.00 284 **Graphics on Plastics – A Reference Guide**
Jodie Laughlin, Kurz Transfer Products

Processes to print, stamp, mark, label or otherwise deposit graphics onto molded plastic products are collectively known as plastics decorating. Given decorating processes, graphic types and production requirements, no single decorating method fits all projects and, conversely, most projects have more than one viable decorating method. For your latest new product design or redesign, one challenge is determining which decorating processes are options. This challenge is an equation of sorts, with several factors to consider, including: 1. graphics details required; 2. molded plastic part characteristics; and 3. performance and production demands. This paper guides a discussion of these factors.

17.30 326 **Comparison of Mass Transit Material Flammability Requirements and Trends for Aircraft and Train Applications in Europe and North America**
Torben Kempers, SABIC Innovative Plastics

Establishing meaningful and reliable flame, smoke and toxicity (FST) requirements for aircraft and train components made from engineering thermoplastics is an ever-evolving task for mass-transit authorities throughout the globe. This paper attempts to clarify the current state of the U.S. and EU regulations, the associated test methods, and typical FST performance of the polymeric materials used today in mass-transit markets. Pending improvements to current FST requirements by the U.S. FAA and the EU EASA regulating bodies, including provisions for heat release and smoke density, are also discussed in detail.

18.00 297 **Low Smoke Noryl® NH6010B Resin for Building & Construction and Transportation Applications**
Kirti Sharma, SABIC Innovative Plastics

Applications like building and construction and mass transit demand that plastic materials comply with robust flame retardance, low smoke and low toxicity (FST) norms established by several regulating agencies. Noryl® is a blend of polyphenylene ether (PPE) and polystyrene. PPE is an inherent char-forming polymer and Noryl® NH6010B utilizes a proprietary smoke-suppressant technology that helps in building robust char during its combustion. The robust char is believed to play a role in reducing the smoke while maintaining outstanding flame retardancy and low toxicity.

18.30 353 **Modeling Container Shelf Life and Top Load Performance**
Scott Steele, Plastic Technologies Inc.

The use of performance modeling is becoming more and more critical to the packaging industry. This trend is driven both by lightweighting efforts and the need to shorten package-development times. The primary driver for reducing the amount of material used in packaging is cost reduction, with environmental positioning an ancillary benefit. However, it is critical not to diminish shelf life or creep performance. Precise modeling of package shelf-life performance is required. The mathematical models considered are M-RULE® Container Performance Model and Virtual Prototyping™ Software. Examples show how computer modeling assists the packager, particularly in regions of the world with temperature extremes. This paper explains key elements necessary to modeling and shows how it has been applied to optimize package performance.

AFTERNOON • MONDAY, 14 NOVEMBER

>>THERMOFORMING: THICK GAUGE

Session Moderator: Daniele Versolato | CENTRO DE CONVENCIONES 3 (CC3) - 3.14

15.00 **Design for Thermoforming: A Case History in Automotive**
Mauro Fae, Self s.r.l.

A correct approach to part design can exploit the great potential of heavy-gauge thermoforming. This case history shows how it is possible, even for uncomplicated parts, to minimize the costs of tools, trimming, parts, and assembly without sacrificing style.

15.30 **Case History on Returnable Packaging**
Marc Omeslagh, Ducaplast SAS

16.00 **A Case of Combination of the 3 Thermoforming Technologies**
Daniele Versolato, Solera-Thermoforming

The presentation will be focused on the development of a structural machine for the food industry that will be introduced into the market in April. This project has been developed internally in our company according to the Set Based Concurrent Engineering Approach – LPPD (Lean Product and Process Development System). In order to obtain the optimum result, the complete machine was developed with the combination of the 3 technologies of thermoforming: High Pressure Forming, Traditional Vacuum-Forming and Twin Sheet Forming with a foam re-enforcement. The briefing of the customer was to have an aesthetical and structural system, to avoid steel as much as possible, no painting afterwards and, in the meantime, to follow all the technical and functional specifications

16.30 **Epoxy Syntactic Foams for Use as Plug Assists in Heavy Gauge Thermoforming**
Kathleen Boivin and Noel Tessier, CMT Materials, Inc.

Traditionally, heavy gauge thermoformers have used plugs/pushers made of wood and felt covered wood to improve material distribution and quality of parts. However, newer materials, especially multilayer structures, can be difficult to form with traditional plug/pusher materials. The performance of epoxy syntactic foams as plug assist materials for heavy gauge thermoforming was evaluated and compared to that of wood.

>>GENERAL BUSINESS

Session Moderator: To Be Named

17.30 221 **Strain Hardening: An Elegant and Fast Method to Predict the Slow Crack Growth Behavior of HDPE Pipe Materials**
Linda Havermans, SABIC IP

A prominent property determining lifetime of HDPE in pipe applications is its resistance to slow crack growth (SCG), usually assessed via testing methods that require testing times of over a year. A sophisticated method in which SCG behavior is correlated to the strain hardening modulus of polyethylene, determined from a simple tensile test has been developed by SABIC. The main advantages are the limited amount of required material and testing times of hours. In a market with increasing demands with respect to SCG behavior a fast and reliable test for quality control of raw materials is an absolute necessity.

18.00 298 **Recycle of Internal and External Streams of Polyetherimide Resin**
Edward Venema, SABIC IP

One of the main advantages of polyetherimide (Ultem* PEI) resin is its high thermal stability, making it an excellent candidate for using internal industrial recycle, external industrial recycle (sprues, runners, parts) and post-consumer recycle as raw material streams. A 30% glass fiber filled grade has been developed using up to 65% of non-virgin material. Mechanical properties were maintained even at high % usage of recycle. Color could be controlled by splitting the non-virgin material into different categories and determining maximum loadings for each. *(Trademark of Sabic Innovative Plastics IP B.V.)

AFTERNOON • MONDAY, 14 NOVEMBER

>>ENGINEERING PROPERTIES AND STRUCTURE
Nanocomposites 2: Nanocarbons

Session Moderator: Brian Landes | CENTRO DE CONVENCIONES 3 (CC3) - 3.13

15.00 **Keynote: Petra Pötschke**

Influencing Factors on Dispersion of CNTs in Polymer Melts

Melt processing of thermoplastic-based nanocomposites is the favoured route for producing electrically conductive or electrostatic-dissipative polymer composites based on conductive fillers, such as carbon nanotubes (CNTs). As these properties are desired at low filler fractions, a high state of dispersion is required in order to realize the intrinsic properties of the individual CNTs. This lecture reviews the influence of nanotube and polymer properties, their interaction, and processing conditions during melt mixing and composite shaping on the state of nanotube dispersion, network formation, and resulting electrical and other properties. Concerning CNT properties, the influences of purity, length, and diameter as well as agglomerate structure are discussed. From the polymer side, melt viscosity, interfacial tension to CNT, and crystallization are discussed. The influence of processing conditions is discussed for small-scale mixing in batch mixers for varying mixing times, speeds, and temperatures. In laboratory-scale extrusion, processing parameters such as rotation speed and throughput, as well as screw configuration, are considered. Shaping conditions, like compression or injection moulding, significantly influence the nanotube networks inside the matrix, as evidenced by morphological and electrical studies. Secondary agglomeration-promoting pathways of conducting nanotubes in the matrix are strongly dependent on time and temperature. Thus, measured conductivity values are influenced by the shaping conditions, especially near the percolation threshold. The lecture concludes by reviewing some applications and properties of CNT-polymer composites based on results at IPF. The nucleation action of nanotubes, the CNT impact on mechanical properties and flame retardancy, and the CNT orientation in melt-spun fibers are discussed. The possibility of tuning electrical properties will be presented for multiphase blends, where the CNTs are selectively localized in one of the phases. As a potential application, the development of a car body panel is presented.

16.00 145 **Interfacial Morphology in Polymer-Based Nano-Carbon Hybrid Structures for Stress Transfer Improvement**

Marilyn Minus, Northeastern University Development of Nanoscale

Composites based on carbonaceous materials and polymers have been researched since the production of carbon fibers in the 1960s, leading to disruptive technological changes in the field of materials science. Today micro- and nano-scale carbon materials have opened new directions within this field to produce composites for high-performance applications. This work outlines in-situ analysis of the polymer-nano interfacial zones in composites as a function of nano-carbon structures. Stress transfer analysis of the composite interface couples nano-carbon structure with morphology and mechanical performance. This work addresses fundamental issues for materials design toward commercialization of polymer-based nano-composites meant for high-performance technologies.

16.30 224 **Filler Re-aggregation and Network Formation in Extruded High Density Polyethylene/ Multi-walled Carbon Nanotube Composites**

Brian Grady, University of Oklahoma

Multi-walled carbon nanotube/high density polyethylene composites with varying amounts of carbon nanotubes were processed in an extruder fitted with a low-shear adaptor. This equipment allowed annealing of the melt for various amounts of time under low shear before it was passed through a slit die. The effect of this treatment on the electrical and mechanical properties of the composites was investigated. Results obtained from extruded samples were compared to the mechanical and electrical properties of samples that had been mixed in a micro-compounder and compression molded. Differences in the crystallinity and the orientation of extruded samples were also assessed.

AFTERNOON • MONDAY, 14 NOVEMBER

17.00 236 **Optimization of Nanocomposite Injection Molding by Design of Experiments**

Pablo Rios, Shenkar College of Engineering and Design

Design of experiments (DOE) is a systematic method based on designed experimental runs used to evaluate the effects of selected variables on final product properties. The method is especially useful when materials are expensive and/or scarce and only small quantities are available for experimentation, such as with carbon nanotubes (CNT). The effects of injection molding on the properties of polycarbonate and polybutylene terephthalate multi-wall CNT composites were studied using DOE. Results demonstrated that although only a small number of experimental runs were used, a significant effect of the injection molding parameters on the properties of the nanocomposites was detected.

17.30 147 **The Effect of Carbon Nanotubes on Properties of Polymer Blends**

Lior Zonder, Shenkar College

Nanocomposites of polyamide 12 (PA)/high-density polyethylene (PE) and multiwall carbon nanotubes (CNT) were prepared in a twin-screw extruder by three different mixing procedures: preblending in the PA phase, preblending in the PE phase, and one-shot blending. The electrical resistivity of the composites and the rheological properties were found to be dependent on the PA/PE ratio in the blend and the mixing procedure, as well as on the CNT loading. The electrical and rheological properties can be explained on the basis of specific localization of the CNT at the interface of the blend, driven by thermodynamics and kinetic effects.

18.00 264 **Carbon Fibre Reinforced LLDPE Developed for Lightweight Applications by Treating the Fibres With a New Type of Coupling Agent**

Csilla Varga, University of Pannonia

We have developed a new type of coupling agent with which processing of long carbon fibre reinforced composites by injection moulding will be possible because fibre breakage is prevented, and simultaneously, mechanical properties are improved. The resistance of LLDPE of 1-10% carbon fibres against tensile and flexure stresses was investigated. Tensile strength was increased by 30% and flexure strength gained 90% relative to the neat polymer. Fibre/matrix interaction was studied on SEM graphs and a polymer layer was observed to be connected to the fibre in the additive-treated fibre containing composites.

18.30 286 **Rheological Characterization of Melt Mixed PCL-MWCNT Nanocomposites Prepared at Different Mixing Speeds**

Petra Pötschke, Leibniz Institute of Polymer Research Dresden

Composites of poly(caprolactone) and multiwalled carbon nanotubes were produced by melt-mixing in a small scale compounder by varying the screw speed to achieve different levels of dispersion. With increasing screw speed, dispersion increases and then levels off starting at about 100 rpm. Melt rheological properties were measured in frequency sweeps. Differences in the complex viscosity and the storage modulus were found in dependence on the mixing speed. Storage modulus at 0.1 rad/s initially increased with decreasing area ratios, showing that storage modulus, especially, is very sensitive to the state of nanotube dispersion.

AFTERNOON • MONDAY, 14 NOVEMBER

>>BIOPOLYMERS

Session Moderator: Jose Lagaron | CENTRO DE CONVENCIONES 3 (CC3) - 3.17

15.00 142 **Improvement of the Thermal Degradation Behaviour of PLLA/MWCNT Composites by Nanotube Purification**
Erlantz Lizundia, University of Basque Country
Knowledge of the thermal degradation behaviour of polymer composites is essential for establishing optimum processing conditions as well as for determining prospective applications. In this work the thermal degradation behaviour of poly(L-lactide) nanocomposites containing both as-received (MWCNT) and purified multiwall carbon nanotubes (p-MWCNTs) was evaluated by means of thermogravimetric analysis (TGA). Composites with MWCNT content up to 5 wt% were prepared by use of a tip-sonication/solvent casting technique. Kissinger and Ozawa-Flynn-Wall kinetics models were used to determine the activation energy (E) of the thermal degradation. Results probe the acceleration of degradation caused by iron and aluminium oxide impurities.

15.30 153 **Silicone Modified Biobased Coatings from Soyabean Oil for Water Resistant Papers**
Shilpa Manjure Northern Technologies Intl. Corp
The silylation chemistry of biobased vegetable oils using alkoxy silanes has been studied and patented. The objective of this work was to evaluate the application of the newly developed silylated soyabean oil formulation as a waterproof coating on paper. Paper coated with the silylated oil was tested for water resistance. Results showed improvements in waterproofing of up to 95% compared with an uncoated, unmodified paper.

16.00 180 **FlourPlast: Creating New Opportunities for the Bioplastic Industry. Process Structure Property Relationships of a Novel Bioplastic Polymer**
Jeroen van Soest, Optimum Optimum
The features of a novel thermoplastic flour are described. Cereal flour itself is not a thermoplastic material. Thermoplastic flour (TPF) is made from a combination of natural-based flours with compatibilising thermoplastic components. Biodegradable TPF is as such made compatible with (biodegradable) polymers such as PLA, PBAT, PHA or PBS. The unique behaviour of this TPF resulted in the development of the FlourPlast product line. A building block system, consisting of precompound granulates, was developed, making it possible to improve processing and product functionality. Process-structure-property relationships were investigated of the new TPF (injection moulded, extruded, thermoformed or film blown) products.

16.30 203 **Synthesis of Elastomeric Phenolic Resins with Improved Toughness and Flexibility**
Francisco Cardona, USQ University
Novel phenolic resins (PF) with improved fracture toughness and flexibility properties were synthesised and evaluated. A first modification consisted in the copolymerization of phenol with a natural renewable component (Cardanol) during the synthesis of PF resins (CPF). An increase in the content of Cardanol resulted in proportional increases in flexural strength and fracture toughness, together with a decrease in the flexural modulus of the cured CPF/PF resins. Further increased plasticizing and toughening effects were observed in the blending of the CPF/PF resins with propylene glycol.

17.00 233 **Enhancing Biopolymers with High Performance Natural Talc Products**
Caroline Abler, Imerys Talc
The effect of talcs on the performance of polylactic acid (PLA) has been studied with a focus on properties of fully crystallized PLA. The results show that talc can be used as an effective nucleation agent to improve mechanical properties of PLA, including stiffness, heat deflection temperature and impact strength. It is also shown in two PLA formulations that Luzenac High Aspect Ratio talc (HAR®) in combination with plasticizers and impact modifiers could further improve crystallization speed and impact properties through modifying the amorphous phase of PLA.

AFTERNOON • MONDAY, 14 NOVEMBER

17.30 249 **Development of Novel Wood Plastic Composites (WPC) Using as Natural Filler Wood from the Recycling of Leisure Sailing Ships**
Mercè de la Fuente, Jordà LEITAT Technological Center
WPC are novel alternatives in certain applications, improving the properties of final products. However, compatibilization between the polymer and the wood fibers is a must. The present research aimed to develop WPC using as the natural fiber recycled wood obtained from out-of-use ships. New challenges in the development of the composites were posed by the highly contaminated wood. After wood-conditioning processes, an extrusion process was carried out to obtain the WPC. The polymers used were LDPE and PP. Four different concentrations of wood fibers were used as well as two different compatibilizing agents.

18.00 259 **Poly(lactic acid) - Investigation and Modification of Mechanical Behavior**
Balazs Imre, Budapest University of Technology and Economics
Both industrial and scientific interest in poly(lactic acid) (PLA) has increased in recent years for various reasons; hopes are rising that this material may represent an alternative to commodity polymers. Thus the thorough characterization and modification of PLA are necessary. This presentation focuses on the mechanical properties, especially the impact resistance, of PLA. Attempts were made to improve this characteristic by blending with both rigid and elastomeric polymer grades. The blends were characterized by various techniques in order to compare toughening methods in these systems, and elucidate the relationship between interactions, structure and macroscopic properties.

18.30 272 **Physical Foaming of Poly(lactic Acid) - Processing and Properties**
Age Larsen, SINTEF
We describe the steps necessary to establish a stable extrusion process of physical foaming of poly(lactic acid) (PLA) with carbon dioxide. The low melt strength and poor thermal stability of PLA play a role in optimizing processing conditions. Up to 10 wt% supercritical CO2 was added. The effect of a chain extender was also tested. Low-density microcellular foams were obtained for three different PLA grades. Foams were characterized by density, cell structure, crystallinity and mechanical compression properties.

MORNING • TUESDAY, 15 NOVEMBER

>>AUTOMOTIVE

Session Moderator: Jean Dauvergne | CENTRO DE CONVENCIONES 3 (CC3) - 3.12

9.00 365 **New Structural Bio Composites for Car Application: Ecoshell Project**
James Njuguna, Cranfield University

Recent advances in research and manufacturing techniques of biocomposites have allowed car manufacturers to use biocomposites in various applications. Biocomposites are emerging as viable alternatives to traditional materials owing to their low cost, light weight, good mechanical performance and biodegradable properties. The ECOSHELL project (development of light, high-performance, environmentally benign composites made of bio-materials and bio-resins for electric car applications) proposes to achieve a full bio-composite made of high-performance natural-resin matrices, resulting in the use of totally natural, environmentally friendly composites, with enhanced strength and bio-degradability characteristics.

9.30 273 **Stabilization of PP/TPO in Automotive Applications**
Marie-Laure Bertet, BASF Schweiz

Both TPO and PP copolymers are widely used for automotive end applications. Overall performances required by OEMs are getting more stringent than ever. Indeed those new market requirements influence the selection of additives and pigments in the compound formulation. Stabilization selection for automotive applications is no longer just a question of their primary functions: light stabilization and long term thermal stability. Secondary properties such as low stickiness, emission and odour reduction are gaining more importance in car interior. The compound components like talcum fillers, carbon black pigment and surface modifiers, influence those performances described above.

>>GENERAL BUSINESS

Session Moderator: To Be Named | CENTRO DE CONVENCIONES 3 (CC3) - 3.12

10.00 98 **Trends and Advances in Multilayer Polymer Structures**
Peter Cox, Peter Cox Associates

Over the years there have always been applications in which a multilayer polymer structure had properties superior to those that any single-layer structure could offer. Despite advances in polymer properties, this phenomenon has continued to grow. This paper will review progress in the areas of packaging, construction, automotive and medical in terms of both polymer properties and manufacturing methods. The role of nanoparticles will be reviewed, along with other methods of reducing permeation through polymers. The production methods reviewed will be mainly those associated with extrusion processes, including injection moulding, cast, sheet, profile and blown film.

10.30 241 **PVC in Europe — Moving Up to the Next Level**
Stuart Patrick, Institute of Materials, Minerals and Mining, London

The paper will briefly review the situation around PVC and sustainability issues over the past ten years in Europe and will move on to update the business outlook for the next five years together with current and future plans around recycling, chemicals legislation and communications based on sound science. The paper will be based on some papers from the recent PVC 2011 Brighton conference with input from Plastics Europe and the British Plastics Federation.

11.00 325 **From Traditional Manufacturing to Research Driven Business in Plastics Technology Using Tampere Model with Strong University Co-operation Aspect : A Success Story of an SME**
Jukka Silén, Tampere University of Technology

A novel theory and methodology were developed to increase and intensify the competitiveness and the business activities of a plastics-industry SME. As result of the research work, the model for R&D, Tampere Model, was created. It is based on four main components: research, networking, university-enterprise cooperation and technology transfer. This paper describes the model, its main results in economical and technological terms using a Finnish SME, Vesita Oy, as a business case. The process has developed the company and its business from small and local concern to research-oriented and international. This has also led to new high-tech products and increasing use of plastic components.

MORNING • TUESDAY, 15 NOVEMBER

>>FAILURE ANALYSIS AND PREVENTION

Session Moderator: Alexander Chudnovsky | CENTRO DE CONVENCIONES 3 (CC3) - 3.14

9.00 226 **PENT and Its Application in Pipe Lifetime Prediction**
Haiying Zhang, University of Illinois at Chicago

A new method has been proposed for evaluating polyethylene pipe lifetimes in brittle failure. This paper presents a detailed review of the theoretical and experimental basis of the new lifetime-prediction method and discusses its limitations. An experimental examination of the proposed method applied to a commercial high-density PE is reported. The results suggest that the proposed method considerably overestimates the lifetime at room temperature. It is inadequate for extrapolating brittle fracture time of PE from 80°C to room temperature. This limitation is related to the changes in the failure mechanism.

9.30 260 **Chemical Degradation–Driven Cracking in PE Pipes**
Byoung-Ho Choi, School of Mechanical Engineering, Korea University

Stress corrosion cracking (SCC) in polyolefin pipes usually starts as a microcrack colony within a degraded layer adjacent to the pipe surface exposed to the combined action of mechanical stress and a chemically aggressive environment. The stage of crack initiation is primarily controlled by chemical degradation, and the second stage is strongly related to the effect of mechano-chemical degradation at the process zone. The interaction of multiple cracks and clusters is typically observed after the cracks grow individually. In this paper, the mechanism of crack initiation and growth due to mechano-chemical degradation is addressed and modeled.

10.00 304 **Imaging Techniques: Innovative Tools for Failure Analysis**
Robert Brüll, German Institute for Polymers (DKI)

The degradation of polymers can be triggered by light and heat. The elemental steps are the loss of stabilizing additives and finally oxidation and chain scission of the polymer. The current approach of analysis is to mechanically abrade layers and then analyze the individual samples by various techniques. Imaging techniques (e.g. infrared or X-ray fluorescence) excel because of their superior spatial resolution and reproducibility. These advantages enable monitoring of the extraction of antioxidants from polypropylene pipes or the loss of stabilizers from polyethylene surfaces upon UV-exposure. New strategies to comprehensively monitor the process of degradation and examples for applications will be presented.

10.30 367 **Proposed UV-Rating Method for UV-Stabilized Injection-Moulding Polyethylene**
Jon Ratzlaff, Chevron Phillips Chemical Company LP

The European injection moulding market is filled with numerous resins that claim resistance to ultraviolet light from outdoor exposure. However, few, if any, have actual comparable data that allows a buyer to distinguish the performance of one resin from another. This paper gives a summary of several published artificial ultraviolet exposure studies, some known standards with industry acceptance and how the tests relate to outdoor exposure with a concise experiment between two UV test methods. Finally, a proposal is given of standardized ultraviolet-resistance testing for the injection moulding world of polyethylene, including estimating outdoor performance.

11.00 258 **Lifetime Prediction in Engineering Plastics — Limitations of Short-Term Test Extrapolations**
Kalyan Sehanobish, The Dow Chemical Company

Using short-term tests to predict future outcomes of any long-term process is common in extrapolation techniques in science, social science and engineering. However, in every process it is important to ascertain some sort of criterion before extrapolation techniques are employed. The criteria for predicting the lifetime of an engineering plastic for a specific application must include the requirements of the test to (a) reproduce the mechanisms of field failures and (b) have a technically sound procedure for extrapolation of a the relatively short test data. We will propose a quantitative modeling approach as an alternative to “empirical” extrapolation.

MORNING • TUESDAY, 15 NOVEMBER

>>RAPID DESIGN, ENGINEERING AND MOLDMAKING

Session Moderator: Alain Choquet | CENTRO DE CONVENCIONES 3 (CC3) - 3.15

9.00 349 **Influence of the Mould Cooling on the Quality and Reproducibility of Injection Moulded Parts**
Silke Allert, Institute of Plastics Processing (IKV) at RWTH Aachen University

The behaviour of a discontinuous technique for cooling injection moulds is compared to that of a continuous system, with a focus on the reproducibility of the process and the dimensional stability of the parts. Both a conventional and a conformal cooling channel geometry are considered. It is discovered that at high mould temperatures, the warpage of the parts can be reduced by use of discontinuous cooling, but at the same time the reproducibility of the process is affected adversely. The regulation of the discontinuous cooling proved to be challenging, especially in combination with conformal cooling.

9.30 266 **Ultraprecision Grinding of Aspheric Cemented Carbide Lens Mold for Plastic Injection Molding**
Akihiko Nemoto, Yamagata University

To cope with increasing demands on ultraprecision profiling and finishing of aspheric lens molds, we have implemented an ultra nanoprecision aspheric grinding system to be mounted with an ELID-capability and on-line feedback capability of profile accuracy. With a grinding process alone, a cemented carbide mold has been successfully ground and finished to have a surface smoothness of several nanometers and ultraprecise profile accuracy. Some specific conditions have been investigated to achieve better accuracy and mold quality. This paper describes those R&D activities and also discusses the latest achievements in this area, showing examples of aspheric lenses produced in these molds.

10.00 332 **Transient Mold Cooling Simulation for the Injection Molding Process**
David Sabaté, Autodesk

In recent years, injection molding technologies have been developed that use variable mold heating and cooling to increase part quality without significantly increasing cycle time. These processes are not suited for simulation with a conventional steady-state (cycle-average) mold thermal analysis. This paper presents the development of a new 3D finite element–based transient mold cooling simulation capability, which includes coupling the mold thermal solution with the mold filling and packing simulation. The predicted transient mold temperatures are validated against measured mold temperatures for two instrumented injection molding trials.

10.30 327 **Mold Optimization For Metal Insert Injection Molding Process**
Massimo Natalini, Università Politecnica delle Marche

High quality and high process efficiency are two of the most important requirements for goods intended for the automotive market. The case study here presented demonstrates how to satisfy quality requirements and increase production efficiency, while reducing production waste. An injection molding process with metal inserts has been analyzed. A new shape for a mold feeding system, including hot runners, has been obtained using the Hagen-Poiseuille relationship as a guideline and an FE model to verify the performance of the proposed solutions. Process performance has been greatly improved.

11.00 111 **Sequential Injection Molding: Design Considerations**
Jorge Aisa, Universidad de Zaragoza

New injection processes have been developed last decades, improving the designer freedom in order to launch attractive functionalities. All these procedures should be carefully analysed before to decide their use, because it is necessary to understand their natural restrictions, cost and operation requirements and rheological implications in the tools construction. This contribution presents a wide study made in the TIIP, research group from the University of Zaragoza, which gives simulation results and experimental values about sequential injection moulding, and some practical considerations for designers and toolmakers in order to get successfully results.

MORNING • TUESDAY, 15 NOVEMBER

>>ADDITIVES AND COLORS EUROPE

Session Moderator: Sam Kenig | CENTRO DE CONVENCIONES 3 (CC3) - 3.17

9.00 113 **Current Applications of Titanates and Zirconates - 2011**
Salvatore Monte, Kenrich Petrochemicals

Titanate and zirconate coupling agents as invented by the author generate 6-7ACS CAS abstracts/week. The author will review the literature and update EUROTEC 2011 attendees on applications in polymers, emphasizing the latest work in nano and green technologies such as biopolymers and landfill biodegradation. The concept of the Six Functions of the Titanate Molecule will be used to explain the effects discussed in the abstracts as viewed from the perspective of the author's 45-year experience in plastics.

9.30 198 **A New Concept to Reduce Odor and Emissions in Polyolefin Compounds**
Jörg Garlinsky, BYK Chemie GmbH

In today's marketplace, especially the automotive industry, reducing emissions of Volatile Organic Compounds (VOCs) is becoming increasingly important. VOCs can be caused by various raw materials such as recycled resins, resins, fillers, impurities and additives. In an effort to minimize or eliminate odor, BYK has developed a new processing additive that can be used during the production process. This paper will elaborate on the concept of odor and emission reduction in polyolefin compounds. The "stripping agent" will assist in reducing VOCs and therefore expand end-uses and markets for polyolefins.

10.00 214 **A New Beta Nucleant Masterbatch for Filled and Unfilled Polypropylene Applications**
Philip Jacoby, Mayzo Inc.

We have developed a unique, highly selective beta nucleant masterbatch that produces high levels of beta crystallinity, and high crystallization temperatures (Tc values). This masterbatch can also be used in polypropylene that already contains other additives which nucleate the alpha crystallinity, such as talc-filled PP. The ability to beta nucleate talc- filled PP creates the possibility of using beta nucleation to achieve both high stiffness and high impact strength in talc-reinforced PP.

10.30 271 **Modification of Amorphous Plastics by Compounding with Colloids**
Viola Sauer, University of Kassel, Institute for Materials Engineering – Polymer Technology

This project attempts to create a new material group: transparent polymer compounds with improved mechanical properties. This should happen by mixing the bulk material with colloids made from the same monomer. Polymer colloids are spheric cross-linked molecules that can be penetrated by linear polymer chains and function as a kind of knot without real chemical cross-linking. The properties of such compounds haven´t been previously analyzed. In this case PMMA is compounded with PMMA colloids (r = 140nm) to increase the yield stress, modulus of elasticity and impact strength. The chemical similarity should provide compatibility and preserve transparency.

>>ENGINEERING PROPERTIES AND STRUCTURE
Composites

Session Moderator: David Arencon | CENTRO DE CONVENCIONES 3 (CC3) - 3.11

9.00 315 **Heat Management in Thermally Conductive Polymer Composites**
Roy l'Abee, SABIC IP

The particle-matrix interface in polymer composites may act as a barrier to heat transport, leading to a particle size and shape-dependent thermal conductivity. In this work, the effect of filler particle size was studied for a model system of poly(butylene terephthalate) and silicon carbide. Within the particle size (0.5-100 m) and volume (20-50 vol%) ranges studied, no influence on thermal conductivity was observed. All experimental data could be well described by the Jiajun model.

MORNING • TUESDAY, 15 NOVEMBER

9.30 115 **Multiblock Polyester Elastomers/Zinc Oxide Composites: Preparation and Characterization**
Goknur Bayram, Middle East Technical University, Department of Chemical Engineering

Thermoplastic elastomers have become increasingly important because they combine the elastic properties of rubber with the processability of thermoplastics. Compounding with fillers can enhance the properties of these polymers. In this study, composites were obtained by introducing zinc oxide (ZnO) fillers into block copolymers of poly(butylene terephthalate) and poly(tetramethylene oxide) by melt compounding. The thermal conductivity and coefficient of thermal expansion of the composites were investigated as a function of zinc oxide type and concentration. It was found that addition of ZnO increased thermal stability, while it decreased the coefficients of thermal expansion of the composites at low temperatures (55-70°C).

10.00 191 **Interlaminar Fracture Toughness of Carbon Fabric Reinforced Epoxy Composites**
Francesco Caimmi, Politecnico di Milano

The Mode I and Mode II fracture behaviours of three carbon-epoxy composite laminates with different fabric reinforcement and different matrices were investigated. Standard double-cantilever-beam and end-notched-flexure delamination tests were performed to determine initiation toughness and to assess the subsequent crack propagation behaviour. Various toughening mechanisms, acting at the microscopic level and responsible for the stick-slip propagation behaviour observed, have been identified. The effect of temperature in a range from -60 to 165 °C was investigated.

10.30 211 **CBT as a Novel Matrix Material and its Processing Techniques for Composites**
Gabor Balogh, Budapest University of Technology and Economics

Cyclic butylene terephthalate (CBT) is a novel thermoplastic matrix material for composites. Beside its low viscosity (0,02 Pas) and superior mechanical properties, CBT has some other advantages over conventional matrix materials. During its polymerization no by-product is made, and it is easy to recycle. But processing of CBT is complicated and may result in a brittle material. Polycaprolactone (PCL) as an additive for CBT will also be introduced to increase toughness. In this paper the proper amount of PCL is determined for obtaining a ductile material, and a method is described for fabricating prepregs and composites.

11.00 320 **High Flow Glass Fiber Filled Aromatic Polyamide Resins**
Frans Mercx, SABIC IP

This paper describes a novel idea of using hyperbranched polymers - dendritic aliphatic polyesters (DAP) as flow promoters in a highly glass fiber reinforced aromatic polyamide (GF-PA) system. Different concentrations and types of DAPs are found to be effective in modifying flow from 10% to 160% with as low as 0.5 to 3 weight % concentration for GF-PA without affecting the enabling mechanical and thermal properties.

>>ENGINEERING PROPERTIES AND STRUCTURE
Applications

Session Moderator: Petroula Tarantili | CENTRO DE CONVENCIONES 3 (CC3) - 3.13

9.00 **Keynote Richard Bopp and Jeff Kolstad**
NatureWorks Ingeo™ Polylactide: From Laboratory Curiosity to Global Commercial Product

10.00 213 **Chain Extension Of Recycled Polyamides: How to Increase the Amount of Recycled PA in the Automotive Industry?**
Elodie Gaouyat, Cray Valley HSC

By 2015, 95% of every end-of-life vehicle should be recycled, providing a substantial source for recycled engineering plastics. Despite improvements in separation technology, blends of plastics appear, especially blends of polyamides, leading to the need for cost-effective method to reintroduce such plastics to the industry. Moreover, reprocessing the materials will create Mw reductions and loss of properties. The focus of this work is to evaluate low-Mw, functional additives as chain extenders in recycled PA blends for reintroducing properties, producing a cost-effective material stream for value-added injection molded goods.

MORNING • TUESDAY, 15 NOVEMBER

10.30 301 **Noryl GTX® for Thermal Breaks**
Jan Matthijssen, SABIC IP

Aluminum's high thermal conductivity makes it less than suitable for window frames unless the inner and outer skin are separated by an insulation insert called a thermal break. Currently, glass-reinforced polyamide 66 is used for this application. Noryl GTX*, however, has a thermal conductivity, measured on an extruded sample, clearly below the thermal conductivity of polyamide. Noryl GTX can also withstand high powder coating curing temperatures, and it meets the mechanical requirements for thermal breaks. Using Noryl GTX will help meet the more stringent upcoming regulations on energy saving.

11.00 294 **Strippability in Cable Extrusion**
Encarna Calvo, Nexans

In the cable industry, the ease with which a piece of jacket can be removed (stripped) from insulated multi-wires is called strippability. A low strip force is not only requested by customers and installers but it also makes the cable more flexible. The purpose of this paper is to present a method based on a numerical approach to reduce the strip force for a cable during extrusion. A correlation between the numerical parameter (pressure applied around the wires) and the strip force measured on samples has been demonstrated; it is used to design future extrusion pressure tooling.

>>ASERM SPANISH ASSOCIATION OF RAPID MANUFACTURING

Session Moderator: Guillermo Reyes Pozo | CENTRO DE CONVENCIONES 3 (CC3) - 3.16

9.00 110 **Flexural Properties and Failure Mechanism Assessment for Additive Manufactured LOM Bars on Different Building Orientations**
Djamila Olivier Gonzalez, Institut Quimic de Sarria

Plastic Laminated Object Manufacturing has not been assessed from the flexural properties point of view. The ability to deflect of parts manufactured by this technique is superior to the parts fabricated by other additive manufacturing methods like SLS or FDM. This fact has increased the interest on the final application of these parts. In this study it will be compared the impact of building orientation and geometric features of the part fabricated over the flexural properties. Through optical observation it will be studied the failure mechanism. Also, it will be presented a method specially fitted by this kind of specimen.

9.30 **Laser Sintered Hybrid Moulds and Micro-Moulds with High Performance and Low-Cost, Thanks to Integrated Conformal Cooling Channels**
C. García-Pando, BBE Engineering

This paper describes how additive manufacturing technologies helped improve the quality and properties of an injection moulded part, and how its injection cycle time was dramatically reduced, thanks to optimized design and manufacturing of a conformational cooling channel integrated in the mould.

10.00 **Rapid Finishing of Free Form Surfaces Using Milling Machine and Spherical Robot**
J.A. Dieste, Universidad de Zaragoza

Fundacion AIITIP is applying new technological sources to develop an automated finishing system, one that can finish free-form surfaces of different material parts and tools with minimum manual intervention. The functions of the new system can be performed by a milling machine or even by a spherical robot.

MORNING • TUESDAY, 15 NOVEMBER

10.30 **Flexural Properties and Failure Mechanism Assessment for Additive Manufactured LOM Bars on Different Building Orientations**
D. Olivier, Institut Quimic de Sarria

Plastic Laminated Object Manufacturing has not been assessed from the point of view of flexural properties. The deflection range of parts manufactured by this technique is higher than that of parts fabricated by other additive manufacturing methods, such as SLS or FDM. This fact has increased interest in the final application of these parts. This study compares the impact of building orientation and geometric features on the flexural properties of manufactured parts.

11.00 **Design & Make | Additive Manufacturing Opportunities for the Design Industry**
Bernat Cuní, Cunicode

Additive manufacturing reduces the complexity of the production process, which means that making products becomes easier and faster than ever. Traditionally, making plastic parts was a privilege reserved to the few who had the resources, but with the immediacy and accessibility of additive manufacturing, combined with the popularization and simplification of design tools and software, new players will join "the venture of producing things." The product-design industry has the opportunity to take new approaches to conceiving, designing, and producing plastic parts.

Knowledge-Assisted Rapid Manufacturing Vojislav Petrovic Metal-Processing Technology Institute KARMA, one of Europe's most important additive manufacturing (AM) projects, deals with the development of a knowledge-assisted automatic assessment tool designed to help end users build AM processes. Based on a complete characterization of different AM technologies and AM processed materials, KARMA assists the end user in learning how different build orientations affect crucial AM aspects: surface quality, support structure, build time and cost. The data on technologies and materials are placed in a KB database, which becomes a source of information for the algorithms that estimate these crucial outcome parameters. This paper briefly describes the KBE DB, its architecture, and its basic functionality.

11:30 **Knowledge-Assisted Rapid Manufacturing**
Vojislav Petrovic, Metal-Processing Technology Institute

KARMA, one of Europe's most important additive manufacturing (AM) projects, deals with the development of a knowledge-assisted automatic assessment tool designed to help end users build AM processes. Based on a complete characterization of different AM technologies and AM processed materials, KARMA assists the end user in learning how different build orientations affect crucial AM aspects: surface quality, support structure, build time and cost. The data on technologies and materials are placed in a KB database, which becomes a source of information for the algorithms that estimate these crucial outcome parameters. This paper briefly describes the KBE DB, its architecture, and its basic functionality.

AFTERNOON • TUESDAY, 15 NOVEMBER

>>AUTOMOTIVE

Session Moderator: Jean Dauvergne | CENTRO DE CONVENCIONES 3 (CC3) - 3.12

15.00 252 **Hybrid Composite Front Seat Backrest**
Thierry Renault, Faurecia Automotive Seating, Brières les Scellés

A car seat backrest was developed by Faurecia and BASF with a new multi-material technology that combines the use of metal, injected polyamide and continuous fiber reinforced thermoplastics. The paper describes the architecture of the seat, the choice of the materials, and the numerical and experimental validation of the structure.

15.30 318 **Lexan* Specialties Copolymers - Performance Attributes for Automotive Applications**
Andries van Zyl, SABIC IP

Lexan* copolymers offer new performance attributes in comparison to conventional polycarbonates by combining building blocks from different monomeric species. In doing so the application space of polycarbonates are expanded to include e.g. weatherability and scratch performance. By improving these attributes on an intrinsic level unique value propositions can be realized which include non-hardcoat or paint-out solutions. This can lead to cost-out opportunities and environmentally friendlier solutions. To emphasize application possibilities in the automotive industry, attributes are considered with regards to scratch, chemical and UV resistance for both Lexan* DMX and SLX resins.

16.00 194 **Engineering-up Polypropylene Composites by Crosslinking with Organosilanes**
Christophe Paulo, Dow Corning Europe s.a.

Polypropylene grafting with α,β-unsaturated carboxylic functional-silanes by melt extrusion processing in the presence of a free-radical initiator was demonstrated while significantly preventing undesired degradation. This modified PP was then used for enabling crosslinking into an injected part of neat PP resin, and enhanced coupling in glass-fiber or cellulose-fiber reinforced PP composites. After the composites were tested at high temperatures, significant improvements were seen in tensile, flexural, and impact resistance, in particular, stability upon heat, water and oil aging. The relevance of this work will be discussed for applications in automotive, appliance, and building, where glass-fiber reinforced polyamide or polyester is often over-engineered.

16.30 302 **Characterizing High Impact Polypropylene by High Temperature Multidimensional Chromatography**
Robert Bruell, DKI

High impact polypropylene (hi-PP) has shown consistent growth rates, most notably in automotive. Fractionation of hi-PP into its components is essential for developing structure-property relationships. High-temperature two-dimensional chromatography (HT-2D LC) opens fundamentally new perspectives for characterizing the molecular heterogeneity of hi-PP. For the first time, a separation of the complete EP rubber phase according to its chemical composition becomes possible. HT-2D-LC uses porous graphite as the stationary phase and solvent gradients as the mobile phase. Starting from the separation of EP model rubbers, we will demonstrate how commercial hi-PP can be chromatographically separated in a comprehensive way.

17.00 137 **Halogen-free Flame Retardant Polyolefin Foams for Automotive Applications**
Silvia Román-Lorza, Fundación Centro Tecnológico Miranda de Ebro (CTME)

A new type of material has been produced by means of creating a cellular structure in blends of LDPE/LLDPE-g-MAH/ATH. The presence of aluminium hydroxide (ATH) in the blend both as a flame retardant and a reinforcement significantly increases the density of the end product. The aim of this work is to achieve a cellular structure by foaming these materials, when high loading levels up to 60wt% of ATH are included. As a result, a density reduction of 50% has been obtained, along with excellent mechanical and flame-retardant properties. A comparison of these properties between solid and foamed materials is included.

17.30 189 **Surface Modification Techniques for Optimizing Adhesion to Automotive Plastics**
Mercedes Tur Escriva, Enercon Industries

Automotive plastics with low polarities, such as PE, PP, TPO, POM, PUR and PTFE, typically require surface treatment when decoration is required. This paper describes the latest innovations in three-dimensional surface treating technology for plastics finishing, which address the need to advance adhesion properties, increase product quality, and achieve environmental objectives within the automotive industry. These innovations include advanced thermal and non-thermal discharge treatment processes for raising the polarity of surfaces to be painted, bonded, decorated, laminated, or printed, or to have tape applied.

AFTERNOON • TUESDAY, 15 NOVEMBER

18.00 268 **ECO+ Solutions for Automotive in High Performance Plastics from DSM**
Bert Havenith, DSM

DSM will present various application solutions in high-performance plastics that enable reduced fuel consumption and/or emission levels, via: 1) friction reduction: nylon 46 in chain tensioners yielding up to 1 % fuel reduction 2) weight reduction (metal-to-plastic conversion): nylon 46 with long-term temperature resistance up to 230C in turbo components, nylon 6 in oil pans/sumps, PET in plastic precision parts 3) electrification: nylon 46 in start/stop and e-motor components, TPC in HV cables 4) improved LCA: biobased materials as PA410 and TPC-Eco. Typical application solutions concern: air induction systems, engine and transmission components, electrical systems, and structural & safety parts.

18.30 85 **Electrically Conductive PC/ABS Polymer Nanocomposites for Automotive Industry**
Michele Modesti, University of Padova

Multiwall carbon nanotubes are widely studied as nanostuctured electrically conductive filler for polymers with high efficiency at low percentages. In this contribution the physical and thermal properties of PC/ABS based nanocomposites obtained by melt compounding and containing different amounts of nanotubes and nanoclay were investigated. A complex selective segregation of fillers inside specific polymer phases has been observed, thus explaining the low percolation threshold obtained for electric conductivity. The goal was to obtain lightweight electrically conductive polymers in order to reduce the chemical treatments necessary for the chrome-plating of the automotive components, with enormous economical and ecological advantages.

>>EXTRUSION

Session Moderator: Paul Andersen | CENTRO DE CONVENCIONES 3 (CC3) - 3.15

15.00 363 **Barrier Coating of Flexible Substrates**
Karim Bahroun, Institute of Plastics Processing (IKV) at RWTH Aachen University

A new coating plant for large-area microwave-excited low-pressure plasma coating with substrate bias has been designed, which allows the coating of foils up to a size of 300 X 300 mm². The objective of the research work is to characterize the effects of the process parameters on the properties of plasma-polymerised coatings, particularly regarding behaviour under strain. Investigations used a microwave plasma source and polyethylene terephthalate (PET) as substrate material. As layer-forming monomers for barrier coating of the substrates, silicon compounds were used.

16.00 77 **High Performance EVOH Nanocomposites of Interest in Packaging Applications**
José Laragon, IATA-CSIC

Ethylene vinyl alcohol (EVOH) copolymers are materials with high barrier properties to gases and vapours. However, their good physical properties become extremely deteriorated at medium high relative humidity or during heat sterilization processes. This paper shows the development of new nanocomposites based on a novel engineered nanoclay commercially presented as O2block, which enhances barrier properties by up to three fold while retaining transparency and reducing the water sensitivity of the polymer.

16.30 89 **Multifunctional Active Nanocomposites for Packaging Applications**
José Laragon, IATA-CSIC, Burjassot, Spain

This paper gathers results on the physical and active performance of melt compounded nanocomposite films containing active nanoclay based additives with oxygen scavenging, antimicrobial and antioxidant performance, of interest in flexible and rigid packaging applications.

17.00 253 **Evaluating the Reactive Blending of PET/PEN in a Twin-screw Extruder: Axial Dispersion Model**
H.A. Khonakdar, School of Chemical Engineering, College of Engineering, University of Tehran

The transesterification of PET and PEN in a twin-screw extruder was investigated. A theoretical model, able to predict the extent of transesterification reaction (X) and degree of randomness (RD) against processing parameters along the screw axis, is presented. PET/PEN blends were prepared via the melt mixing process. The axial dispersion model (ADM) was developed for modeling the twin screw extruder. Extent of transesterification reaction and degree of randomness was examined via H-NMR. Theoretical and experimental results were in good agreement, allowing the prediction of the X and RD as a function of processing parameters such as time, temperature and composition.

AFTERNOON • TUESDAY, 15 NOVEMBER

>>FAILURE ANALYSIS AND PREVENTION

Session Moderator: Monika Verheij | CENTRO DE CONVENCIONES 3 (CC3) - 3.16

15.00 184 **Fundamentals and Practice of Plastics Failure Analysis**
Myer Ezrin

It usually comes as a surprise when a plastic product fails. Plastics are made to succeed, not to fail. Sometimes the financial liability can be high, such as a waterline break that is not detected and causes major property damage. If there is a fatality due to plastics failure, criminal charges may be brought. A company can be forced into bankruptcy by plastics failure. So answering the question "Why do some plastic products fail and others don't?" is an exercise of major importance. The answer involves choices of chemical composition, molecular weight, design, processing and service conditions.

15.30 360 **Failure Analysis: Migration of Pigments & Slip Additive Case Studies from the Indian Sub-Continent**
Francis Rodrigues, Plastiblends India Ltd

The role of slip additives in product failure due to their migration to the surface of plastic films is explored. Five case studies highlight different aspects of the complex inter-relationships that exist between the base resins, the slip additive in the base resins, slip agents added by the film processor in the form of masterbatches, the color pigments , processing conditions / storage conditions, and the products, which are subsequently packed inside flexible pouches or flexible laminates.

16.00 227 **Cold Drawing and Its Role in Fracture of Polyolefin Pipes**
Alexander Chudnovsky, University of Illinois at Chicago

The ductile failure of polyolefin pipes results from material instability on the macroscale. It appears as a ballooning resulting from large-scale strain localization similar to that observed in cold drawing. The brittle fracture is manifested in cracking with no large deformation on the macroscale. There is a localized crazing in front of the crack, which consists of micro fibers and membranes. It also results from cold drawing, but on the microscale. This paper presents analysis of cold drawing as time-dependent phase transition referred to as "delayed necking". The connections between ductile and brittle failure of polyolefin pipes and delayed necking are discussed.

16.30 299 **Deformation and Failure Mechanisms in Polyolefines and the Role of the Entanglement Network**
Rudy Deblieck, SABIC IP

Macroscopic deformation and failure modes are reviewed in terms of craze propagation and craze-crack transition models. The importance of the entanglement network is reflected by the tensile strain hardening behaviour which is shown to be a robust measure for crack growth resistance. This approach also explains theexistence of two brittle-ductile transitions, one at low temperature linked with chain scission, the other at elevated temperatures linked with disentanglement crazing. The relation between these transitions and the molecular mobility transitions such as Tg and the alfa-relaxation are discussed. Strategies for increasing the crack propagation resistance are reviewed.

17.00 225 **Reliability Analysis of PB Tubing in Cold Water Distribution System**
Zhenwen Zhou, University of Illinois at Chicago

The effect of weathering on blends was evaluated via Fourier transformation infrared (FTIR) analysis and differential scanning calorimetry (DSC).

17.30 230 **A New Closed-Loop Mold-Temperature-Control Technique by Means of Online Thermography**
Georg Schwalme, SKZ Süddeutsches Kunststoff-Zentrum

A number of water utilities in various states in the USA have reported persistent premature failure of polybutylene tubing in water-distribution systems. A failure analysis of a PB system and a methodology of reliability analysis are presented. Reliability analysis allows predicting future failures. The proposed methodology is validated by comparison of failure prediction with actually reported field failures in selected water districts from Maryland, Georgia and Ohio. The methodology also allows a rational plan for replacement by considering the effect of preventive replacement programs on the reduction of emergency replacements. The main PB failure mechanisms in potable water applications are discussed.

AFTERNOON • TUESDAY, 15 NOVEMBER

18.00 368 **Polyethylene: Process Sensitivity in Rotational Molding**
Jon Ratzlaff, Chevron Phillips Chemical Company LP

Rotational molding is a unique process that puts unusual demands on the average polyethylene. This paper looks at the optimum process conditions for different polyethylenes and the sensitivity of impact properties to the oven time and temperature. Process conditions become critical for maintaining impact properties while running multiple types of molds on one spider or varying from standard process conditions with like molds.

>>MEDICAL POLYMERS EUROPE
Novel Polymers and Unique Applications

Session Moderators: Austin Coffey and Len Czuba | CENTRO DE CONVENCIONES 3 (CC3) - 3.14

15.00 95 **Polysiloxane Layered Silicate Hybrids — Modelling of Mech Performance in Relation with Nanocomposite Structure**
S.P. Vasilakos, University of Athens

Nanocomposites based on condensation type polysiloxane rubber, reinforced with organically modified montmorillonite nanoparticles, were prepared via sonication. Two types of commercial montmorillonite, namely Cloisite 20A and Cloisite 30B, with different types of organic modification were studied. A significant improvement of mechanical properties of the pure polysiloxane was observed by the incorporation of the examined types of clay reinforcements. The comparison between experimental and theoretical values of elastic modulus was performed by the use of the micromechanical simulation models, such as the Halpin-Tsai model, which interrelates Young's modulus with clay structure in the nanocomposite.

15.30 **Development of a Polyether-block-amide/montmorillonite (MMT) Nanocomposite for Use in Angioplasty Balloon Applications**
James Kennedy, Athlone institute of Technology

The focus of this study investigates the effects of organically modified montmorillonite nanoclay within a polyether-block-amide (Pebax) matrix for angioplasty balloon applications. Interactions between the Pebax and nanoclay are reflected in the DMTA results which show significant increase in storage modulus and a broader relaxation at the Tg. Confirmation was established by the use of tensile tests where the ultimate tensile strength and the strain at break were found to increase, which are desired properties.

16.00 362 **In-Vitro Modeling of Blood Vessels**
Austin Coffey, Waterford Institute of Technology

Models of human blood vessels can be used for assistance in future research of new medical devices that can be preliminarily tested in an in vitro setting and that could potentially lead to breakthroughs in the medical device industry. Recently, there has been a trend toward replicating the properties of blood vessels more accurately. The use of hydrogels has the potential to achieve this, as it is possible to accurately represent arterial properties. Artificial blood vessels have been developed using a casting process.

16.30 285 **Material Testing and Qualification for Today's Advanced Medical Devices**
Len Czuba, Czuba Enterprises

Medical device designers and engineers are tasked with selecting just the right polymer for their devices; and this requires keeping in mind all the various requirements that must be satisfied including functional requirements, chemical and biological requirements and manufacturing, assembly and sterilization. Collectively, results of the evaluation of the materials used in the construction of medical devices and the function of the devices together contribute to what many refer to as the biocompatibility of the device. This paper will review some of the steps necessary to ensure the right materials are used to make your advanced new medical device.

AFTERNOON • TUESDAY, 15 NOVEMBER

17.00 239 **Physicochemical Properties of Plasma Polymerized Acrylic Acid, ε-caprolactone and Lactic Acid Films**
Aitor Larranaga, University of the Basque

The physicochemical properties of plasma polymerized films were investigated by means of X-ray photoelectron spectroscopy (XPS), Fourier Transform infrared spectrophotometry (FTIR), ellipsometry and water contact angle. Three different monomers (acrylic acid, ε- caprolactone and lactic acid) were polymerized in a plasma polymerization system for different times (7, 15 and 30 min) and power conditions (80 and 120 W). While plasma polymerized acrylic acid and - caprolactone shared a strong similarity with the conventional polymers, lactic acid did not bear any resemblance to the conventional polymer.

17.30 228 **Novel Copolyesters For Housewares and Medical Applications**
Ludovic Gardet, Eastman

Novel, tough, transparent copolyesters have been recently developed by Eastman Chemical Company. These new polymers known under the trade name Eastman Tritan™ copolyesters have higher glass transition temperatures than traditional copolyesters while keeping the benefits of transparency and excellent chemical resistance combined with outstanding toughness. The properties of Tritan copolyesters allow it to be used in applications in a variety of markets from housewares to medical. This paper describes the basic chemistry and structure-property relationships of Tritan copolyesters. These results are discussed in the context of other commercial engineering theromopalstic polymers such as polycarbonate, styrenics and acrylics. In addition, this paper describes the properties for some of the commercial Tritan copolyesters grades available and how they compare to other common thermoplastics.

18.00 204 **Hydrophobic Thermoplastic Polyurethanes**
Anthony Walder, Lubrizol

Thermoplastic polyurethanes (TPUs) are a class of thermoplastic elastomers (TPEs) that are used in a variety of medical applications. TPUs exhibit low temperature flexibility, excellent abrasion resistance, high tensile strength and good processing characteristics. The softest TPUs historically used in medical applications exhibit a Shore Durometer above 70A. A medical grade TPU with a Shore Durometer of 62A will be presented. This softness is achieved without the use of plasticizers, as is often the case with other soft TPEs.

>>ADDITIVES AND COLORS EUROPE

Session Moderator: Alex Capuz | CENTRO DE CONVENCIONES 3 (CC3) - 3.17

15.00 281 **Dispersion and Mixing Characteristics of High-Volume and High-Torque Twin-Screw Extruders**
Michael Thummert, Leistritz Extrusionstechnik GmbH

Twin-screw extruders with large volumes and high torques are widely utilized in the compounding industry. This paper presents specific research on the residence time distribution and energy input for these machines. It shows the result of the machine technology in terms of various processes, such as production of colour masterbatches, technical compounds, and filler concentrates. The paper also deals with various questions such as process window, throughput increase, and how flexible extrusion lines can be.

15.30 312 **Effect of Common Stabilizers on the Long-term Heat Ageing Performance of Polyetherimides**
Miguel Angel Navarro de Castro, SABIC Innovative Plastics

A fast method was developed to predict the macroscopic properties of molded resin specimens tested in the UL® RTI test (tensile strength retention) with microscopic properties that can be easily measured (molecular weight). By using higher temperatures than employed in the UL RTI protocol, accelerated ageing can be achieved in pellets. Polyetherimide (PEI) resin was spiked during extrusion with common stabilizers. The analysis focused on melt stability, rheology and long-term heat ageing performance. Hindered phenol stabilizers were detrimental under accelerated thermo-oxidative ageing of PEI. The use of new stabilizers should be carefully considered.

AFTERNOON • TUESDAY, 15 NOVEMBER

16.00 334 **Nanominerals and Nano-oxides**
Yatish Vasudeo, Innovations Consultancy India Pvt. Ltd

Nanoclays have to intercalate and exfoliate. Nanoclay powders normally have BET surface areas of 5m2/gm or less. To disperse such a powder from 5 to 750m2/gm is difficult. Thus there has been a re-examination of minerals that are platy, such as talc and mica. The finest talc has a BET surface area of 15m2/gm. It is possible to further grind this talc (also mica) along the basal cleavage down to 100 to 200m2/gm. Such talcs can improve polymer properties.

16.30 339 **"Digital Sampling" Bridging the Gap Between Virtual Reality and Color Development in Automotive Interiors**
Walter Franz, Data Color, Inc.

"Digital Sampling" as a method to accelerate color-development processes in automotive interiors is explored. Using this technique reduces the number of cycles needed for color approvals by 50%, and it is applicable to 80% of all interior parts. "Virtual Reality Solutions" are widely used in automotive applications. This paper will show the benefits of linking Digital Sampling with Virtual Reality techniques and the resulting impact of realized time and cost savings on the bottom line.

17.00 370 **Material Handling and Blending Systems for Molding and Extrusion**
Keith Larson, ACS Group

The auxiliary equipment in a plastics-processing plant is an integral part of the success of that operation. Material handling, blending, feeding, crystallizing, drying, temperature control, process cooling and size reduction equipment can affect the process and consume a considerable amount of energy. People often spend a significant amount of time researching the primary machine but pay little attention to the auxiliary equipment. Most of this equipment also uses a lot of energy, so it is worthwhile considering some optional energy-saving and environmentally friendly features.

17.30 **Antifogs for Plastics: From Simple Molecules to Complex Systems**
Roberto Todesco, SABO International

Surfactants, chemicals characterized by a lipophilic and hydrophilic part, are traditionally used in detergent and cosmetic applications. Today these products find wide application in plastics as antistatic, antifog or dispersing and/or wetting agents.

18.00 **Iron Oxides and Zinc Ferrites as Cost Effective and High Performance Solutions in Plastics**
Dani Llado, Nubiola,

In today's Plastics industry, high performance pigments are seldom associated with cost effective results. Historically, Iron Oxides and Zinc Ferrites have never been considered high performance pigments. With this paper Nubiola revisits this idea and presents these pigments as both cost effective and high performing products. Either alone, combined together or in combination with organic and other inorganic pigments Iron Oxides and Zinc Ferrites open the door to successful color solutions.

>> ENGINEERING PROPERTIES AND STRUCTURE
Foams and Blown Films

Session Moderator: Dick Bopp | CENTRO DE CONVENCIONES 3 (CC3) - 3.11

15.00 205 **Determining the Morphology of Chemically Foamed HIPS Pipe Coating Using Image Segmentation**
Terje Tofteberg, SINTEF Materials and Chemistry

A method for rapidly characterizing the shape, size and distribution of bubbles in foam has been developed. The method is based on the extraction of bubble shapes from high-resolution images of microscopy slices of the foam, using image segmentation. The foam studied is the 30-mm-thick high-impact polystyrene (HIPS) coating of a thermally insulated pipe. The coating is applied using extrusion with a chemical foaming agent and the image segmentation provides a dataset with the ellipse fit of 500.000 bubbles.

AFTERNOON • TUESDAY, 15 NOVEMBER

15.30 134 **Production of Polypropylene (PP) foams from a Conventional PP Grade.**
Cristina Saiz-Arroyo, University of Valladolid

Analysis of Cellular Structure and Mechanical Properties Foaming of polypropylene is not easily accomplished, because of its weak melt strength and its semicrystalline character. The solutions proposed until now are based on crosslinking the polymeric matrix or on the use of special polypropylene grades. A collection of samples with relative densities in the range of 0.3-0.6 have been produced using a conventional PP grade. The improved compression moulding foaming process, which uses a chemical blowing agent, was used to produce the analyzed foams. The effect of chemical composition on both cellular and mechanical properties has been analyzed.

16.00 129 **Improving the Thermal Insulation of Extruded Polystyrene Foams by the Addition of Carbon Black.**
Juan Lobos, University of Valladolid

This papers presents an investigation on improvements in thermal conductivity of extruded foams by using different types of carbon black as an additive. Carbon blacks with different morphologies were used as IR-blockers. To test the changes in the conductivity, foams with densities around 30 kg/m3 were produced using the solid-state foaming technique. The cellular structure and thermal conductivity were analysed in detail. The thermal conductivity was analytically modelled to study the influence of the different carbon black types on the heat flow by radiation. The best morphology to reduce thermal conductivity has been selected.

16.30 276 **Microwave Enhanced Foaming of Selected Polymeric Materials**
Aleksander Prociak, Cracow University of Technology

In this paper, the ability of different thermoplastic polymers [polyurethane, poly(vinyl chloride) and carbon black–filled polypropylene] to absorb microwave irradiation and to be foamed using chemical blowing agents is discussed. The temperature changes of such materials under microwave irradiation of various intensities were investigated. Selected polymeric materials with additive of chemical blowing agents were foamed under microwave irradiation, and the influence of foaming conditions on cell structure and apparent density of porous products was analyzed.

17.00 126 **Effect of Nanoadditives in Rigid Polyurethane Foam Nucleation Monitored by X-ray Radioscopy**
Samuel Pardo-Alonso, CellMat Laboratory, Condensed Matter Physics Dept. University of Valladolid

X-ray radioscopy is a technique in which a series of high-resolution/high-sensitivity radiographies are acquired during an evolving process. The present study aims to investigate the mechanisms occurring during the reactive foaming process of polyurethane (PU) foams for first time by this novel powerful technique. Part of the work focuses on the comparative study of nucleation phenomena in PU foams with/without nanoadditives (nanoclays), definitely proving that nanoparticles increase the number of nucleation centers, reducing the final cell-size. In addition, this technique permits researchers to determine the pore size evolution versus time for the different PU formulations used.

17.30 152 **Fire Behaviour of Flame-retardant Rigid Polypropylene Foams**
Vera Realinho, Centre Català del Plàstic

Well known is the growing interest in some industry sectors in reducing the high flammability of polymers, as this limits their suitability in applications where fire retardancy is required, while at the same time maintaining some of the advantages related to their lightness. This work presents the development of new lightweight multifunctional fire-retardant composites based on polypropylene filled with hydrated magnesium carbonate-based flame-retardant systems. Particularly, interesting flame-retardancy synergistic effects were observed in the polypropylene composite foams by means of cone calorimetry by combining the magnesium carbonate with intumescent formulations and layered nanoparticles.

AFTERNOON • TUESDAY, 15 NOVEMBER

18.00 222 **Toughness of Microcellular Polycarbonate Foams and Its Temperature Dependence**
Martin Rohleder, University Kassel

This investigation analyses the notched impact strength of microcellular polycarbonate produced by injection moulding using physical blowing agents. By varying different processing parameters, such as blowing agent concentration or the injection velocity, injection moulded plates were produced and characterised with regard to morphology and the Charpy notched impact strength. A temperature-dependent analysis concerning the correlation between the foam morphology and the notched impact strength was carried out. Additionally, investigations were performed to determine if the failure mechanisms, which occur at low temperatures, also function the same when exposed to temperatures higher than 80°C.

18.30 108 **Correlation Between Different Micro-structural Parameters with Physical/mechanical Properties of Polyethylene Blown Films**
Shokoh Fatahi, Shaw Energy & Chemicals Group

This paper addresses the correlation between tensile properties and microstructure parameters of polyethylene.

>>ENGINEERING PROPERTIES AND STRUCTURE
Thermoplastics

Session Moderator: Brian Grady | CENTRO DE CONVENCIONES 3 (CC3) - 3.13

15.00 283 **Upgrading Performance of Recycled Polyamide with Zemac®**
Ashok Adur, Vertellus Specialties Inc.

A vast amount of recycled polyamide comes from the carpet and textile and other industries. Owing to degradation and loss of viscosity, this recycled polyamide has reduced performance and limited use. The unique chemistry of alternating copolymers of ethylene and maleic anhydride provide several advantages for upgrading recycled polyamide. This paper discusses the results of compounding prime-grade polyamide as well as recycled polyamide with the addition of small quantities of these copolymers and specific property improvements for applications in injection molded compounds.

15.30 100 **Investigation of the Chemical Resistance and the Material Aging Conditions of Polyethylene for Pipe Applications**
Anita Redhead, Polymer Competence Center Leoben GmbH

The chemical resistance of polyethylene for pipe applications was investigated with regard to physical and chemical material aging. Tensile tests were conducted on films that were exposed to two different aggressive media for different predefined periods of time and at two different temperatures, and on films not exposed to the media. The impact of the media on the Young´s modulus, the stress at yield, the strain at yield and the strain at failure was studied. Potentially physical or chemical material aging was investigated by the degree of crystallinity, the oxidation induction time, and Infrared spectroscopy.

16.00 183 **Natural Gas as Main Energy Source for Polymer Plasticizing with a Specially Designed Heat Exchanger**
Felix Heinzler, University of Duisburg-Essen

This paper deals with an alternative method for plasticizing polymer materials. The plasticizing process is one of the most energy-intensive aspects of polymer processing. Reducing energy cost is possible only by changing the principle of plasticizing. Described here is a new plasticizing system, based on the primary energy carrier, natural gas, getting the polymer in a molten state. Hence conversion losses can be decreased, by improving the efficiency of the direct heat transfer. A specially designed heat-exchanger with natural gas-based heaters is the key technology. In addition to the concept, the layout of a demonstrator is described.

AFTERNOON • TUESDAY, 15 NOVEMBER

16.30 68 **Radiation Crosslinking: High-Performance Materials for Plastic Moulded Parts**
Miguel Morales, IONISOS IBERICA

Radiation crosslinking has been used since the 1970s for halogen-free and heat-resistant cables and wires, for hot-water pipes or for heat shrinkable tubes, and tyres. More recently, the technology has been developed rapidly for plastic moulded parts, and not only by means of electron beams (largely used for extruded products), but also under gamma rays, which considerably improve the performance of a great number of thermoplastics, elastomers, and TPEs. The technology reinforces their dimensional stability in chemically aggressive and high-temperature conditions. Such modified polymers offer new material potentialities and solutions for various sectors: packaging, automotive, E&E.

17.00 251 **Material Modelling for Simulating Impact Loading of Injection-moulded Polypropylene Parts**
Erik Andreassen, SINTEF

This paper describes the calibration and verification of a material model used in the numerical simulation of mechanical loading. The material model features strain rate-dependent yield stress, pressure-dependent yield stress, plastic dilatation and damage. The model was calibrated with data from tests in tension, shear and compression. Two load cases were simulated: centrally loaded plates and three-point bending of bars. The predictions of force vs. deflection were good to fair. The results are discussed in terms of deficiencies of the calibration data, heterogeneity and anisotropy of the injection-moulded components, and shortcomings of the model.

17.30 114 **Kinetics and Chemical Reactions of Acetaldehyde Stripping Process in Poly(ethylene terephthalate) Resin**
Saleh Jabarin, University of Toledo

The kinetics of acetaldehyde (AA) stripping from PET pellets were determined at different temperatures, along with the determination of the residual concentrations of other less volatile compounds such as 2-methyl-1,3-dioxolane (2MD) and ethylene glycol (EG). Rate constants for polymerization and AA diffusivity coefficients were determined. The air stripping of AA from PET is shown to involve chemical reactions and physical changes including polymerization, diffusion, and generation of AA, 2MD, EG and water. This paper will discuss the mechanisms of the chemical reactions and the formation of the by-products. Analytical methods: gas chromatography, nuclear magnetic resonance spectroscopy, intrinsic viscosity, density and color.

18.00 331 **A Phenomenological Constitutive Model for Strain Softening Prediction in Semi-crystalline Polymers**
Mariajosé Pineda, Investigación y Desarrollo C.A.

Strain softening is one of the most important viscoelastic characteristics of semi-crystalline polymers, and these materials are very sensitive to temperature and strain rate. A new phenomenological model with strain, strain rate and temperature dependence on stress was developed based on the G'sell & Jonas model with a new expression used to predict the strain-softening phenomena, completing the whole mechanical behavior of polymers from initial strain, strain softening and part of the strain hardening. Model verification was performed on four materials and it was developed to further study the complex deformation patterns in thermoplastic materials subjected to impact loads.

18.30 307 **Self-Consistent Field Simulation of the Equilbrium Morphology of Polyolefin Multi-Component Systems**
Klaas Remerie, SABIC IP

Polypropylene impact-copolymers are among the structurally most complex systems. A solid understanding of morphology formation, despite its importance for product properties, has been hampered by analytical hurdles, as well as the mathematical complexity of a rigorous multi-component approach of the underlying thermodynamics. In this paper a full characterization of molar mass and composition distribution provides input for a numerical Self-Consistent Field simulation of equilibrium morphology and interfacial tension. Over a broad range of compositions, a stratified droplet proves to be the most stable configuration. This approach is shown to significantly increase understanding of factors governing morphology formation.

9.00 - 18.00 • Monday and Tuesday, 14-15 November

INTERACTIVE POSTER PRESENTATION

76 Structure and Property Changes Induced by Weathering to Various Plastic Packaging Films
Petroula Tarantili, National Technical Univ. of Athens

The rheological behaviour, morphology and mechanical properties of in-reactor alloys of polypropylene (PP)/ethylene propylene rubber (EPR) synthesized by a multi-stage sequential polymerization process are studied in this article. Scanning electron microscopy (SEM), oscillation rheometry and mechanical tests were used to determine relationships between polymerization parameters, morphology, rheology and mechanical properties, which can be a useful method to tailor the blend structure. Electron microscopy revealed that by increasing switching frequencies in polymerization time, the size of the EPR dispersed phase decreases and the interconnection between the matrix and rubber domain is improved.

81 The Effect of Composition and Processing Parameters on the Morphology and Properties of Polycarbonate/Poly(acrylonitrile-butadiene-styrene)/Organoclay Nanocomposites
Petroula Tarantili, National Technical Univ. of Athens

In this work, blends based on polycarbonate (PC) and poly(acrylonitrile-butadiene-styrene) (ABS) were prepared and studied, in an attempt to explore the performance of mixtures deriving from the recycling of waste electrical and electronic equipment (WEEE). Modification of ABS/PC blends via incorporation of reinforcing fillers, such as organic modified montmorillonite nanoparticles (OMMT), was also studied. These mixtures can be easily processed. They display enhanced chemical and thermal stability, acceptable mechanical properties with reasonable cost, providing at the same time an interesting approach to the management of plastic waste from electrical and electronic devices.

82 The Synthesis of PP/EPR In-Reactor Alloys by Split-Feed Sequential Polymerization Process and Its Effect on Rheology and Morphology
Yousef Jahani, Iran Polymer & Petrochemical Institute

We present the combination of a HAAKE MARS rotational rheometer and an FT-IR spectrometer in order to simultaneously collect rheological data and IR spectra.

87 Determination of Molecular Structures as a Function of Time and Deformation by Means of Simultaneous Rheometry and FT-IR Spectroscopy
Jan Plog Thermo Fisher Scientific

The failure of a mould-part used for hot-forming is investigated. The die, made from AISI H13 steel, was intended for the production of plastic cups. The mould-part exhibited a crack after five million working-cycles, whereas its predicted working life was ten million cycles. Data were collected regarding the material selection, manufacture and operational history. The die was optically inspected. Hardness measurements were carried out and chemical analysis was performed. Samples were prepared for optical and electron microscopy. The type of failure and the factors that caused it are studied and suggestions are presented, in order to avoid similar situations.

88 Lab Scale Development and Industrial Scale-up of PET-Based Nanocomposites Technology for Packaging Applications
Michele Modesti, University of Padova

Tires consist of synthetic rubber, metals and linen. European legislation requires their recycling, which includes: shredding in strips, strip cutting, and powder production. This paper discusses the failure analysis of a cutting tool used in the shredding machine. A preliminary examination was conducted, historical data were collected, and the broken parts were visually inspected and macroscopically examined. Hardness measurements and chemical analysis were performed and the tool's material was identified. The paper presents conclusions on the fracture mechanism and refers to the principal causes that led to the failure. The results may prove useful for industries using similar cutting machinery.

9.00 - 18.00 • Monday and Tuesday, 14-15 November

INTERACTIVE POSTER PRESENTATION

101 Impress, an Innovative Pilot Injection-compression Moulding Platform for the Production of Micro-nanostructures on Plastic Parts
Mael Moguedet, PEP Centre Technique De La Plasturgie

IMPRESS targets the development of a technological injection moulding platform for serial production of plastic components incorporating micro or nano scale functional features. The platform is based on most advanced facilities divided in three modules: tool manufacturing, involving different technologies of micro-nano direct manufacturing, from top-down to bottom-up such as self-assembling; injection moulding, including equipment fitted with innovative hardware technologies to improve replication quality and capability; and intelligence, dedicated to advanced process control and online metrology integration. In addition, three case studies will be presented on biology, health and energy applications.

106 Microscopic Examination of a Hot Working Tool Used for Plastic Injection
Carmen Medrea, Technological Education Institute of Piraeus

Thermoplastic elastomers have become increasingly important because they combine the elastic properties of rubber with the processability of thermoplastics. Compounding with fillers can enhance the properties of these polymers. In this study, composites were obtained by introducing zinc oxide (ZnO) fillers into block copolymers of poly(butylene terephthalate) and poly(tetramethylene oxide) by melt compounding. The thermal conductivity and coefficient of thermal expansion of the composites were investigated as a function of zinc oxide type and concentration. It was found that addition of ZnO increased thermal stability, while it decreased the coefficients of thermal expansion of the composites at low temperatures (55-70°C).

107 Preliminary Failure Examination of a Tool Used in Tire Waste Recycling. Case Studies
Carmen Medrea, Technological Education Institute of Piraeus

The razor blade method traditionally employed in fracture-toughness characterization of polymers creates plastic deformation at the notch tip, which affects the fracture-toughness values. A new technique based on femtosecond pulsed laser ablation removes material with almost no heat dissipation, preventing melting and thermal deformation of the surrounding area and without plastic deformation at the crack tip. In this work, the fracture toughness of polycarbonate was studied using the Linear Elastic Fracture Mechanics testing procedure at impact velocity, evaluating the influence of crack sharpening by femtolaser or razor blade sliding.

115 Multiblock Polyester Elastomers/Zinc Oxide Composites: Preparation and Characterization
Goknur Bayram, Middle East Technical University, Department of Chemical Engineering

Created at the University of Zaragoza in 1989, the T.I.I.P. group has developed its activities around injection moulding. This team has always worked as closely as possible with industry (its name includes "workshop" rather than "laboratory"), and among its aims it promotes research work that responds to market demands. For effective knowledge exchange, T.I.I.P. members have promoted hundreds of training courses teaching how to improve the entire injection moulding process. Since the inception of the T.I.I.P., fifteen doctoral theses have been completed and twenty computer training programs have been developed.

125 Fracture of Polycarbonate. Notch Sharpening by Femtolaser Ablation
David Arencon, Centre Català del Plàstic. Universitat Politècnica de Catalunya

The razor blade method traditionally employed in fracture-toughness characterization of polymers creates plastic deformation at the notch tip, which affects the fracture-toughness values. A new technique based on femtosecond pulsed laser ablation removes material with almost no heat dissipation, preventing melting and thermal deformation of the surrounding area and without plastic deformation at the crack tip. In this work, the fracture toughness of polycarbonate was studied using the Linear Elastic Fracture Mechanics testing procedure at impact velocity, evaluating the influence of crack sharpening by femtolaser or razor blade sliding.

136 T.I.I.P.: A Training And Research Group in Injection Moulding
Jorge Aisa, Universidad de Zaragoza

Viscoelastic flow in a Maddock Kneader in which the screw has rotating motion is simulated. Linear viscoelastic responses are considered using both the Maxwell model and the Boltzmann superposition model. Calculations are made first in a basic screw element and subsequently in Kneader screw modules where we consider leakage flows through the leakage screw flights. Our study includes filled length variation in the crosshead screw extruder, screw characteristics of Kneader screw elements, and pressure profiles along the modular Kneader machine.

9.00 - 18.00 • Monday and Tuesday, 14-15 November

INTERACTIVE POSTER PRESENTATION

197 Modeling of Maddock Kneader by Flluent
Reza Darvishi, Kimia Javid Co.

In this study, friction and wear properties of two high-temperature-resistant polymers, an amorphous polyetherimide (PEI) and a crystalline polyetheretherketone (PEEK), were investigated at specific combinations of high pressure, velocity, and temperature; the properties were compared with those of smooth steel counterparts. The effects of internal lubricants–polytetrafluoroethylene (PTFE) and PTFE with short fiber reinforcements (carbon fiber)–are outlined. Tests were performed on a thrustwasher testing machine under dry sliding conditions. Different analytical techniques were employed to study the correlation between the transfer layer and wear properties. Lubricated and lubricated-reinforced compounds showed excellent wear properties, compared with pristine resins, throughout all PV conditions.

220 Transport Parameters of Deactivated Polyorthoaminophenol Film Electrodes
Ricardo Tucceri INIFTA (Instituto de Investigaciones Fisicoquímicas Teóricas y Aplicadas)

Poly(o-aminophenol) (POAP) films were deactivated and then reactivated, and dependences of the different charge-transport and charge-transfer parameters on the degree of deactivation (θc) were obtained by employing Electrochemical Impedance Spectroscopy. While some parameters, such as interfacial metal-film and film-solution resistances, high-frequency capacitance, and redox capacitance, exhibit a continuous variation without hysteresis between deactivation and reactivation processes within the whole θc range, others, such as electron and ion diffusion coefficients, show not only marked changes of slope from given c values but also hysteresis between consecutive deactivation and reactivation processes.

248 Evaluation of Tribological Behavior of Amorphous and Crystalline Thermoplastic Compounds Under High Pressure, Velocity and Temperature Conditions
Reema Sinha, General Electric

Aluminum's high thermal conductivity makes it less than suitable for window frames unless the inner and outer skin are separated by an insulation insert called a thermal break. Currently, glass-reinforced polyamide 66 is used for this application. Noryl GTX*, however, has a thermal conductivity, measured on an extruded sample, clearly below the thermal conductivity of polyamide. Noryl GTX can also withstand high powder coating curing temperatures, and it meets the mechanical requirements for thermal breaks. Using Noryl GTX will help meet the more stringent upcoming regulations on energy saving.

250 Mechanical Testing of Polypropylene Materials in Shear Analysed by Digital Image Correlation
Erik Andreassen, SINTEF

Three polypropylene-based materials (two talc-filled compounds and one unfilled homopolymer) were tested with two in-plane shear test methods (Iosipescu and V-notched rail). The three materials behaved differently in the shear tests. Most notably, cracks developed in tension near the notches for the particle-filled materials, while the unfilled homopolymer did not fracture. There were also differences between the materials regarding strain localisation between the notches, and thickness change in the sheared section. The stress-strain curves obtained with the two shear tests were quite similar.

253 Evaluating the Reactive Blending of PET/PEN in a Twin-screw Extruder: Axial Dispersion Model
H.A. Khonakdar, Iran Polymer and Petrochemical Institute

In this study composite materials based on HDPE with fillers containing nanostructures were prepared using melt mixing. Vapour Grown Carbon Fibers (VGCF), multiwalled carbon nanotubes (MWCNT), anthracite powder, microsilica, organoclay and expanded graphite (EG), as well as mixtures of these fillers, were used. The amount and mixing ratios of the hybrid filled systems have been varied to determine the effect on the achievable level of thermal conductivity. The filler dispersion and phase adhesion were studied using scanning electron microscopy. When limiting the filler content to 10 wt%, the highest enhancement in thermal conductivity by 166% was found for VGCF.

9.00 - 18.00 • Monday and Tuesday, 14-15 November

INTERACTIVE POSTER PRESENTATION

270 Acoustic Transmission Properties of Plastics Compounds
Peter Allan, Brunel University

The acoustic properties of plastics compounds are an important consideration for many industrial applications. One such property is the 'sound transmission loss' (STL). Currently there is no standard test for this, but there is a standard method for the determination of sound impedance and absorption. The equipment used for this standard can, however, be adapted to measure the sound transmission property. The presentation will describe the initial results on a project that is evaluating the test method for STL, and some of the relationships between the STL and the physical structure of materials will be discussed.

282 Surface Energy Effects of PC/SAN/MWCNT Blends with the Addition of a Reactive Component
Vicki Flaris, BCC of CUNY

The effect of accelerated weathering on the structure and properties of single, metallized and multilayer films used in food packaging was studied, by exposing specimens to repeated ageing cycles under the combined action of UV, humidity and heat. Films made of polypropylene (PP) undergo severe chain scission upon irradiation and lose mechanical properties, but still retain their impermeability to water vapour. The metallic coating cannot prevent PP from degradation. PE and PET films show modest decreases in mechanical properties. Multilayer films (PE/EVOH/PE, PE//PET) present a decrease in mechanical properties according to that of their weakest component.

301 Noryl GTX® for Thermal Breaks Plastic Parts for a Float-Valve System were Designed
Jan Matthijssen, SABIC-IP

The design considered the use of PET bottles as floating devices instead of regular spheres, in order to promote the reuse of plastic containers and to decrease plastic residues. Additionally, part thickness was reduced to use less plastic in the parts, and to decrease cycle times. All molds are two-plate and two-cavity. The refrigerating system proposed uses a U-shape channel, and the expulsion system is composed by ejector pins. The threaded connector mold is more complex because it requires two-step opening.

343 High-throughput Compounding: A Faster and More Cost-effective Way to Develop New Thermoplastic Formulations
Markus Gross, Polymaterials AG

In this work, blends based on polycarbonate (PC) and poly(acrylonitrile-butadiene-styrene) (ABS) were prepared and studied, in an attempt to explore the performance of mixtures deriving from the recycling of waste electrical and electronic equipment (WEEE). Modification of ABS/PC blends via incorporation of reinforcing fillers, such as organic modified montmorillonite nanoparticles (OMMT), was also studied. These mixtures can be easily processed; they display enhanced chemical and thermal stability and acceptable mechanical properties at a reasonable cost, providing at the same time an interesting approach to the management of plastic waste from electrical and electronic devices.

346 Thermal Conductivity of Hybrid Filled HDPE Nanocomposites
Michael Müller, Leibniz Institute of Polymer Research Dresden

352 Design of Injection Molds for Floating Valve System Using PET Bottles as Floating Device
Mariangel Berroteran, Universidad Simón Bolívar

358 On Multiscale Simulation of Thermoplastic Parts – Calculating Molecular Orientation
Barbara Heesel, Institute of Plastics Processing at RWTH Aachen University

The general aim of the Cluster of Excellence "Integrative Production Technology for High-Wage Countries" is to overcome the actual contradictions between value- and planning-orientation as well as between scale and scope in production technology. One important aspect of this approach is the development of virtual production systems to increase simulation accuracy and thereby to reduce development times and costs as well as to optimise the utilisation of material. In this paper, new developments in the field of the calculation of molecular orientation are described and a validation with different experimental measurements is presented.

9.00 - 18.00 • Monday and Tuesday, 14-15 November

STUDENT POSTER PRESENTATION

1 New Wire Drawing Extrusion Tip

Daniel Haller, Jean-Marc Gonnet, Christian Lankes; Nexans NRC

In cable extrusion the weld line in the cable coating forms in the side-fed mandrel die. The weld line runs along the length of the cable coating and has the least favorable orientation relative to the circumferential stresses. Therefore a new wire drawing extrusion tip with spiral channels was developed, to change the orientation of the weld line from radial to circumferential. To design the new wire drawing extrusion tip, a design strategy based on two-dimensional flow networks was applied. CFD-simulations of particle path lines were used to analyzed the re-orientation of the weld line in the tip and showed that the new extrusion tool works well.

2 Novel Design of Roofing Tiles Based on Recycled Thermoplastic Materials

Ana Gallego Murillo, London Metropolitan University

This increasing amount of disposed post-consumer thermoplastics requires a solution for achieving an efficient use of the raw material and the oil consumption. Building and construction sector is one of the biggest thermoplastics consumers and therefore, it is possible to introduce products with high content in recycled plastics from packaging. The principal aim of this work has consisted on trying to achieve the redesign of a product from the Building and Construction sector using post-consumer thermoplastics to make it environmentally sustainable. The work has consisted on redesigning a roofing tile and maximising its recycled content by proposing the use of recycled PET and HDPE, as well as two composites; one using different percentages in weight of recycled PET and HDPE and another using recycled HDPE and wood flour. The prototype has been developed using sketch drawings, CAD drawing and 3D Rapid Prototyping to verify that the overlapping between the tiles is correct and flexible. In addition, mechanical calculations have been carried out to study the implementation of ribs for a possible thickness reduction to achieve material savings.

3 Micro-Indentation: A New Method for Condition Monitoring of PVC Pipes

E. Drenth, T.C. Bor, H.A. Visser, M. Wolters; University of Twente

The PVC pipes in the Dutch water and gas distribution networks show embrittlement which can lead to (fatal) incidents during third-party digging activities. Condition monitoring of the PVC network is therefore essential to safeguard future operations. One important cause for condition changes in time is physical aging which causes embrittlement of the PVC pipes. A micro-indentation based experimental approach proves that the degree of physical aging can be determined quantitatively in a non-destructive way.

4 Development of an In-situ Polymerized PLA Nanocompound with Enhanced Barrier Properties

Jesús Ambrosio-Martín, Amparo López-Rubio, J.M. Lagarón Institute Agrochemical and Food Technology (IATA-CSIC); Novel Materials and Nanotechnology Group

The aim of this work was to establish a methodology based on in-situ melt polycondensation to develop nanocomposites with enhanced barrier properties using poly(lactic acid) (PLA) as the matrix and a biobased isolated by-product as a nanoreinforcing filler (patent pending). The parameters of the process were optimized to obtain a novel compound with excellent optical properties and the ability to reduce permeability to oxygen and water by more than 50% in compression molded films.

5 Effect of Different Modifying Agents on PET/Organosepiolite Nanocomposites Properties

T. Fernández, R. Gallego, D. García-López, J. Viña, A. Fernández

1 Innovation Department, LINPAC PACKAGING. La Calzada - Vegafriosa, 33128 Pravia – Asturias, Spain.

2 CIDAUT, Foundation for Research and Development in Transport and Energy. Technological Park of Boecillo, 47151 Valladolid, Spain.

3 Department of Materials Science and Metallurgical Engineering, University of Oviedo. Campus de Viesques, s/n, 33203 Gijón, Spain.

The present work is based on the production of packaging from PET/organosepiolite nanocomposites sheets by rigid extrusion and thermoforming process. The first step of the process is the sheet extrusion of PET/organosepiolite nanocomposites. It has been observed that in PET/organosepiolite nanocomposites a diminution of the properties is observed during the melt compounding process due to the hydrolytic degradation of PET. Different modifiers of sepiolites and chain extenders have been studied in the nanocomposite production in order to diminish the hydrolytic degradation. From the best results, PET/organosepiolite sheets have been fabricated through a standard rigid extrusion process with adequate properties.

9.00 - 18.00 • Monday and Tuesday, 14-15 November

STUDENT POSTER PRESENTATION

6 Measurement of Gas Permeation Properties of Extruded Thick Wall Hollow Cylinder Plastics

Süleyman DEVECI, Tamer BIRTANE, Mualla ONER; Yildiz Technical University

Gas transport properties of polymeric materials are very important subject for food packing films, gas separation membranes and barrier materials. Due to easy of test setup and gas independent measurement, time-lag technic is the most common method of calculating permeation properties of polymers. But, most of the published literature focused on measurement of thin polymer films using mathematical models in Cartesian coordinates.

In this research, a new measurement system was developed for thick wall hollow cylinders, like polypropylene pipes for hot water service. Gas transport properties of these polypropylene pipes were calculated using mathematical models in cylindrical coordinates.

7 Potential Biostrength Modifiers for Bioplastics

K Manjula Dilkushi Silva, Brunel University

Intrinsically unique poly (lactic acid) polymer (PLA) from renewable resources is in the forefront of the scientific research today due to the impact of petroleum based plastics on the environment and depletion of the finite fossil resources. In this research work, PLA was blended with bioimpact modifier to evaluate its properties, thereby producing flexible strands via extrusion processing. The strands were pelletised and injection moulded to make test specimens. The extrudates were analysed and investigated for thermal behaviour, mechanical properties, microstructure, and water absorption. Furthermore, modifiers were also evaluated against the blends of PLA and starch in search of desirable properties. Tensile and impact properties were also investigated including physical ageing after storage for one year. The addition of biostrength modifiers to pure PLA does not influence the melt stability of the blend. Poly lactic acid (PLA) with bio-strength impact modifier made a huge difference in increasing elongation at break and a relatively high impact strength. The tensile test results demonstrate that elongation at break increased by a factor of 8, and falling dart impact test results exhibited that impact strength increased by a factor of 4 compared to that of the control PLA samples, at 6% impact modifier. Moreover, the impact modifier decreased water absorption of the blend and the melt strength modifier also increased the elongation.

8 Experimental Study of Plastic Rotomoulded Parts and Reinforced with Natural Fibers

Yolanda Fernández Perdomo, Antonio Nizardo Benítez Vega y Zaida Ortega Medina, Universidad de las Palmas de Gran Canaria

Experimental study of reinforced plastics parts by natural fibers, banana fiber, obtained by rotational molding process. To carry out this process without opening the mold, the design and development of a device for adding materials in various stages of transformation is being approached. This allows introduce reinforce material into the matrix without contact with the internal wall of the mold. Natural fiber used comes from waste obtained from banana plantation, providing an extra value to the plantation.

9 The Effect of Processing Conditions Upon Structure and Orientation in Polypropylene - clay Nanocomposites

Linda Thiraphattaraphun and Robert J Young, The University of Manchester

In this research, Polypropylene (PP)-clay nanocomposites were prepared by melt mixing using twin-screw extrusion and subsequent processing by compression and injection moulding. The PP crystallite orientation was monitored using two-dimensional X-ray diffraction (2D-XRD). In addition the effect of clay on the PP crystalline orientation was investigated. It was observed that in injection-moulded PP-clay nanocomposites both the PP a- and b- phases are present while, compression-moulded PP-clay nanocomposites showed only the PP a- phase. Moreover, the incorporation of clay to PP matrix does not encourage the formation of the PP b-phase compression-moulded samples.

9.00 - 18.00 • Monday and Tuesday, 14-15 November

STUDENT POSTER PRESENTATION

10 **Natural Fibre Biocomposites into Structural Vehicle Components: Progress and Challenges**

Elias Nassiopoulos, Jiying Fan, James Brighton, Alain De Larminat, James Njuguna; University of Cranfield

The climatic changes and emerging environmental concerns, the reduction of global oil capacity, and the increased public awareness of the problems caused by plastic waste, dictate a turn into 'green' technologies, eco-design, and environmentally friendly materials. For the automotive industry, being for years a big part of the problem, this change is now vital.

Biocomposites are fast emerging as viable alternative to traditional materials due to their low cost, lightweight, good mechanical performance and biodegradable properties. Over the last decade, intensive research and developments have been carried out in order to develop bio-composites, based on vegetable or mineral fibres, with resins coming also from natural sources. Now, Mercedes, Audi, Toyota, Renault, Peugeot, Volvo, Lotus, are just some of the car manufacturers using natural fibre composites for non-structural components such as the dashboard, door panels, seat backs, package trays and numerous others.

As of today, however, the relatively lower properties and several technical considerations not yet solved, limit the use of bio-composites into structural applications. Working on a full vehicle design, ECOSHELL project aims to address these issues resulting with new light high-performance environmentally benign composites made of bio-materials and bio-resins for electric car applications. Employing both experimental and simulation studies, ECOSHELL will end with new materials, new manufacturing and degradation processes, as well as working solutions for automotive components.

The first results from mechanical testing of 0/90° woven and non woven flax/bioepoxy composites outlines the challenges in addressing strength, stiffness and impact performance of all bio-composite structures. However the mechanical performance of unidirectional flax fibres/bioepoxy composites combined with their very low density shows great potential to be used in a loaded electric vehicle component. Experimental results and findings will be presented and discussed. Further, initial finite element analysis on natural fibre biocomposites, along with their weaknesses and limitations will be addressed.

11 **Stages Molding. A New Technology for the Production of Plastic Parts. Area: Automotive.**

J. Escudero, J. Tirado, M.A. Rodriguez-Perez, J.A. de Saja, D. Rosa, J.A. Vazquez; University of Valladolid

This Student Poster presents a novel technology to produce plastic parts called "Stages Moulding". The patented technology allows producing plastic parts with complex shapes, from a wide variety of polymers, with excellent surface quality, reduced thermal and mechanical stresses and the possibility to produce parts with reduced weights among other interesting advantages. Moreover, this novel process uses much cheaper moulds and machinery than those used in injection moulding. The specific characteristics previously mentioned make this technology very promising for the production of moulded plastic parts. The Student Poster summarises the main characteristics of this technology presenting some real examples of parts produced.

12 **Surface Energy Effects of PC/SAN/MWCNT Blends with the Addition of a Reactive Component**

Cherie Fletcher, Manisha Bandamede, Vicki Flaris; BCC of CUNY

Blending immiscible polymers with the addition of nanoadditives is a suitable method for tailoring properties of materials. Carbon nanotubes (CNTs) have versatile properties as fillers influencing several properties of polymers favorably. Some of the applications of these materials are in the semi-conductor and transistor industries. Contact angle measurements were calculated using Drop Shape Analysis. The data was fitted in an Owens-Wendt plot to determine surface energy values. Localization properties of MWCNT's with/without reactive component were examined with an Atomic Force Microscope. In this paper the morphological data is correlated to conductivity.

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