GRADUATE STUDENT POSTERS

2016-G01

Title: Novel Production of Textured Carbon-Fiber composites with enhanced hydrophobicity

Author: Ali Anwer

University: University of Toronto

This poster details the development of compliant textured surfaces based on fibrous composites that possess enhanced hydrophobic surface wetting properties. The fibrous composites consist of a hard carbon fiber (CF) phase reinforcing a compliant thermoplastic polyurethane (TPU) matrix – fabricated using melt blending and injection molding. The carbon fiber phase is textured such that it is aligned transversally and protruding out of the elastomer surface. This is achieved by mechanically cutting and rearranging a longitudinally aligned molded composite. The textured surface brought about by the aligned and protruded carbon fibers is apparent in both the surface morphology of the composites. Contact angle wetting studies indicate that the fiber protrusions enhances the hydrophobicity of the surface. A maximum contact angle of 112° is observed with a carbon fiber content of 16vol%, representing a 39% improvement in the surface hydrophobicity over unreinforced TPU (81°). The textured fiber reinforced composites in this study represents a facile method to enhance hydrophobicity of composites without the need for any additional surface coating or post-process texturing.

2016-G02

Title: Improving Abrasion Resistance of Biopolymer Coatings on Poly (lactic acid) Films

Author: Zarif Farhana Mohd Aris

University: University of Massachusetts Lowell

The accumulation of large amounts of plastic packaging film waste in sea and landfills have led to increased interest in alternative biodegradable packaging materials. Compostable plastics have been looked upon as a sustainable alternative. Polylactic acid (PLA) is one the most popular biodegradable being explored for numerous applications. However, the oxygen and water vapor barrier properties of PLA are poor, rendering it unsuitable for many barrier-packaging applications. Metallization and multilayer coatings are common strategies to improve barrier properties of PLA. Unfortunately, they adversely affect biodegradation and recyclability. Coating of biodegradable polymers such as chitosan has been reported to improve oxygen barrier properties of PLA while preserving the biodegradability. However the poor abrasion resistance of these coatings has restricted its industrial applications.

Although cross-linking is a common approach to improve the properties of coatings, current cross-linking methods are either expensive, toxic or do not impart the desired properties to the cross-linked materials. This work describes the cross-linking of chitosan onto PLA films using food grade sodium tripolyphosphate (TPP) to improve the abrasion resistance while retaining the barrier properties. These coated translucent films retained good barrier and mechanical properties with providing improved abrasion resistance after crosslinking. This approach provides exciting new possibilities for expanding the use of biodegradable polymers in packaging applications.

2016-G03

Title: Thermoreversible syndiotactic polystyrene based ionogel membranes for electrochemical application

Author: Prasad Raut

University: The University of Akron

Electrochemical devices have recently developed substantial interest due to their use in electric vehicles (EV), hybrid electric vehicle (HEV), plug-in hybrid vehicles (PHEV) and energy storage of green power grids. This catalyzed extensive usage of lithium-ion batteries (Li-ion) due to their high energy and power densities. A major concern about the use of Li-ion technology include their stability at high temperature. Materials for electrolyte and separator are key component for development of safe and stable Li-ion batteries. Commercial polypropylene (PP), polyethylene (PE) based separators undergo melting during thermal runway causing a short circuit between electrodes. This leads to fire, explosion of the cell due to use of flammable, volatile carbonate based solvents. This work focuses on use of thermally stable porous syndiotactic polystyrene (sPS) membranes filled with ionic liquid (IL) to form the ionogel membrane. This approach combines the thermal stability and ruggedness of the polymer and the attributes of IL, e.g. extremely low volatility and non-flammability of IL. Porous sPS membrane show high IL electrolyte uptake (> 90 % wt.), increased thermal stability (upto 270 °C for sPS) compared to commercial PP separator (160 °C). These ionogel membranes are tested using Li+/ graphite half-cells assembly for electrochemical performance. sPS-IL based membrane shows lower impedance and higher specific capacity over the commercial membrane.

2016-G05

Title: Polymeric and Ceramic Nanofibers from Novel Gas Jet Fiber Spinning

Author: Monoj Ghosh

University: The University of Akron

One dimensional (1-D) nanofibers can play a vital role in the fields of filtration, opto-electronic, sensor, solar cell, catalysis etc. Here, we demonstrate a novel Gas Jet Fiber (GJF) spinning technique for fabrication of polymer and inorganic oxide or ceramic nanofibers with controlled morphologies and size. The current technique can produce fibers with higher production rate, at least 30 times higher for the same fiber diameter compared to single jet electrospinning. For example, titanium dioxide (TiO2) nanofibers of diameter 50-300 nm are fabricated by calcining at 500-700 □C in air. The nanofibers are obtained from spinning solutions of polyvinylpyrrolidone (PVP) and titanium isopropoxide (TTIP). The morphology and chemical structure of the precursor polymer and calcined fibers are characterized by scanning electron microscopy (SEM), thermo gravimetric analysis (TGA), transmission electron microscopy (TEM), and X-ray diffraction (XRD). Furthermore, GJF-spun core-shell and side-by-side morphologies of polymer nanofibers such as polyvinyl acetate (PVAc)-polyethylene oxide (PEO) and PVP-PEO are also demonstrated.

2016-G07

Title: Comparison of the Solution and Rheological Properties of Side-Chain Liquid Crystalline Polyacrylates (SCLCPs) with Linear, Star, Comb and Hyperbranched Architectures

Author: Dibyendu Debnath

University: University of Akron

The effect of the architecture on the rheological properties (i.e. solution viscosity, melt viscosity (isotropic viscosity) and anisotropic viscosity) of side-chain liquid crystalline polymers (SCLCPs) was studied. SCLCPs with linear, three-arm star, six-arm star, comb and hyperbranched architectures were synthesized by ATRP. These polymers were fractionated to obtain polymers with narrow molecular weight distributions to minimize the effect of polydispersity. The intrinsic viscosities and Mark-Houwink-Sakurada exponents at a specific molecular weight for the branched polymers were lower than those of linear polymer, and decreased with increasing branching. The melt viscosity at a specific molecular weight follows the same trend: hyperbranched < comb < six-arm star < three-arm star < linear. The activation energy for the flow of the branched polymer is higher than that of the linear polymer, implying that the melt viscosity of the branched polymer is more sensitive to the temperature than that of the linear polymer. The anisotropic viscosity in the smectic A mesophase of these polymers were similar as a function of the shear rate with little effect of architecture. Nevertheless, the storage and loss modulii were independent of the temperature in the smectic A mesophase, but depended on the molecular weight, especially with the linear polymer. The frequency dependencies of the storage and loss modulii at lower frequency side indicated that all of the architectures form well-defined layered microstructures at temperatures below the isotropization temperature. The molecular weight dependency of both melt and anisotropic viscosities of the linear and branched polymers exhibited no evidence of entanglement and the molecular weights were therefore lower than the entanglement molecular weights.

2016-G09

Title: Investigating Cellular Distributions in Supercritical Fluid Assisted Foam Injection Molded PLA/PBSA Blends

Author: Sai Aditya Pradeep

University: Clemson University

CAFE standards for 2025 have set a fleet-wide average of 54.5 MPG and reducing cumulative emissions by 6 billion MT of CO2. This has prompted the automotive industry to renew their focus on lightweighting materials, particularly polymeric composites which bring weight savings while ensuring safety. Conventional plastics are practically non-renewable as they are sourced from crude oil. Biopolymers prepared from renewable food and non-food sources offer a potential alternative. Blending biopolymers with inherently toughened counterparts enhances their properties. This study investigates the foam morphology of polylactic acid–polybutylene succinate adipate blends processed via supercritical fluid assisted injection molding. Cell morphology, size and density were determined by SEM, while mechanical properties were studied via tensile testing. Crystallization kinetics and viscoelastic behavior were studied via differential scanning calorimetry and dynamic mechanical analyzer respectively.

2016-G11

Title: Cavitation Erosion on Polyurea Coatings

Author: Harsh Sanghvi

University: UMass Lowell

Cavitation Erosion on Polyurea Coatings

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Abstract

This poster summarizes an experimental research to evaluate the cavitation erosion resistance of different formulations of Polyurea(PU) coatings in accordance with ASTM G32-10. Three different formulation using amine (Versalink650, Versalink1000 and a blend of Versalink250 and Versalink1000) and Isocyanate (MDI) were prepared. Mechanical, thermal and morphological properties of the coatings were studied using DMA, MDSC, FTIR and AFM. Coatings were exposed to cavitation in accordance with ASTM G32-10. Eroded surface were gauged using Dektak Profilometer and mass/volume loss analysis. The ultimate objective of this project is to establish structure/property relations for variants of PU for this application.

2016-G13

Title: Applications of Core Retraction in Manufacturing Low-Density Polypropylene Foams in Microcellular Injection Molding

Author: Rebecca Shotwell

University: University of Wisconsin

Microcellular Injection Molding (MIM) faces limitations in density reduction and part thickness. Core retraction MIM offers a means of expanding these boundaries. In this process, the melt is injected into a thin cavity, cooled for a short time, and then allowed to expand and nucleate by retracting a core in the mold. In this study, polypropylene (PP) was molded using N2 as a blowing agent. Core retraction MIM was compared to traditional fixed volume MIM and different delay times and weight reductions were tested. It was shown that core retraction MIM yields parts with better cell structure and a controllable polymer-rich skin layer. Core retraction MIM achieved greater weight reductions with fewer defects and more consistent properties as compared to fixed volume MIM.

2016-G14

Title: Stochastic Modeling of the Uncertainties of the Injection Molding Process

Author: Linda Gesenhues

University:

Uncertainties of the injection molding process are stochastically modeled. A system is considered showing the interaction of the clamping unit and the mold. Therefore, a deterministic equation is obtained modeling the system simplified as a set-up of springs in order to easily determine the resulting forces in the load path of the system. As an example for uncertain process parameters the mold temperature and the pressure force of the injected polymer are chosen. The Monte Carlo method is used to receive the stochastic results for the mean and the probability interval. Furthermore, an optimization algorithm is applied to improve the system in terms of the stiffness of the clamping unit and the temperature variation of the mold. This procedure is well suited to predict possible failures which appear only very seldom and therefore would not be revealed by commonly used set-up procedures.

2016-G15

Title: Bimodal Amphiphilic Conetworks in Biomedical Applications: Structure-property relationship and real-time morphology evolution during film formation

Author: Gustavo Guzman

University: The University of Akron

Amphiphilic conetworks (APCNs) are two-component networks of covalently interconnected hydrophilic/hydrophobic (HI/HO) phases of co-continuous morphology; as such they swell both in water and hydrocarbons, and respond to changes in the medium by morphological isomerization ('smart' networks)" [1]. APCN's have been of interest in recent years for their applications in soft contact lenses, biosensors, bio-catalysis and immunoisolation [2].

We report the development and characterization of Bimodal Amphiphilic conetworks (bAPCN) of Polydimethylsiloxane(PDMS) (2 molecular weights) and Poly(N,N-dimethylacrylamide) (PDMAA) for the first time. Conetworks were designed to contain a small percentage of a very high molecular weight PDMS (1-5%) and different crosslink levels. Using these two chemical "dials" we were able to considerably alter and fine-tune relevant functional properties including mechanical strength, swelling ratios, surface morphology, and diffusion rates of hormones and antibodies. Drying and film formation of bimodal amphiphilic conetworks solutions in THF were investigated by a novel custom designed [3] measurement system that tracks real time weight, thickness, surface temperature, and in-plane and out-of-plane birefringence. The surface composition was also followed in real time during drying by determining the contact angle. The morphological development in bulk and at surfaces of Amphiphilic conetworks during film formation was investigated for the first time.

1-Erdodi, G., & Kennedy, J. P. (2006). Amphiphilic conetworks: Definition, synthesis, applications.

Progress in Polymer Science, 31(1), 1–18

2-Dech, S., Cramer, T., Ladisch, R., Bruns, N., & Tiller, J. C. (2011). Solid-solid interface adsorption of proteins and enzymes in nanophase-separated amphiphilic conetworks. Biomacromolecules, 12(5), 1594–601.

3-Unsal, E., Drum, J., Yucel, O., Nugay, I. I., Yalcin, B., & Cakmak, M. (2012). Real-time measurement system for tracking birefringence, weight, thickness, and surface temperature during drying of solution cast coatings and films. The Review of Scientific Instruments, 83(2), 025114.

2016-G16

Title: Rheological and solid-liquid interaction study of MWCNT-phosphonium ionic liquid nanofluids

Author: Sayali Satam

University: The University of Akron

Carbon nanotubes (CNTs), because of their excellent properties, have been used as additives to improve mechanical, thermal, electrical and tribological properties of the matrix. However, CNTs have a strong tendency to aggregate because of their nanosize and high surface energy. CNTs are chemically modified to achieve good dispersion in the matrix, which can damage its structural properties. Therefore, their physical modification using surfactants is preferred. Ionic liquids, which are room temperature salts, form well dispersed matrix with CNTs because of cation-π or Vander Waals interactions between the two. This study investigates the solid-liquid interaction between MWCNTs and phosphonium ionic liquid. The rheological properties of the MWCNT-IL mixture are also studied at different compositions as it can provide more detailed information about microstructure of nanofluids.

2016-G17

Title: Shrinkage Reduction of Injection Molded Parts

Author: Muralidhar Reddy Lingam

University: Bradley University

The shrinkage of injection molded plastic parts is very common and undesirable. It is affected by many factors such as part geometry, mold design, processing parameters, material properties, etc. Mold design typically takes estimated material shrinkage into consideration. However, due to many factors affecting part shrinkage, the injection molded parts may not meet tight design specifications. It may not be always feasible to modify part design and mold design at this stage, which is extremely expensive. This study aims to reduce shrinkage by adding a small amount of environmentally benign additive (e.g., wood fiber), without considerable change in the properties of final parts. Experimental studies were conducted to investigate the shrinkage reduction effects of different additives at different content levels, as well as the increased mechanical properties. The results would provide guidance on the selection of additive type and content for shrinkage reduction without involving costly mold modification.

2016-G18

Title: Rational Co-Design of Polymer Dielectrics for Energy Storage

Author: Gregory Treich

University: University of Connecticut

Materials discovery has long been driven by intuition and serendipity as exemplified by Thomas Edison's search for the best lightbulb filament. A way to go beyond this trial and error based approach is through computational predictions as has been adopted by the pharmaceutical industry. These approaches have been increasingly desired in modern materials research as a way to cut cost and increase the effectiveness of synthetic efforts. In this work, we show how the emerging rational co-design approach involving cooperation between high-throughput computational screening, experimental synthesis, and testing can be used in the field of polymer dielectrics. These efforts have helped to identify subsets within large classes of traditional organic polymers, such as polyimides, polyureas, polythioureas, and polyurethanes. In addition, a new class of organometallic polymers was investigated to expand the chemical space and drive further energy research.

2016-G19

Title: Nonlinear Mechano-Optical Behavior Of Phenylalanine-Based Poly(Ester Urea): Local Order in Amorphous Polymers

Author: Keke Chen

University:

The mechano-optical behavior of melt-compressed amorphous phenylalanine-based poly(ester urea) (PEU) films was studied in their rubbery state under uniaxial deformation. The study focused on the effect of different diol chain length within PEU chemical structure, and was carried out by a real-time measurement system that can capture true stress, true strain and real-time birefringence during stretching. When subjected to deformation at low temperatures above Tg, materials exhibit photoelastic behavior contributed by the initial glassy component as segment-segment contact dominates. At higher temperatures above Tg, PEU with relatively shorter diol chain length shows the liquid-liquid (Tll) transition at about 1.06 Tg (K), in which the material transforms from a “liquid of fixed-structure” to a “true liquid” state and the initial photoelastic behavior disappears.

The effect of hydrogen bonding on the physical properties of PEUs was also studied. Fourier transform infrared spectroscopy (FTIR) was used to characterize the distribution of hydrogen bonds in PEU polymers as a function of temperature. The FTIR spectra indicates that the strength of hydrogen bonding diminishes with increasing temperature. In the case of PEUs with the longest diol chain length, integration of the area associated with N-H stretching region exhibits a linear dependence of temperature. However, the integrated area of N-H stretching region changes with temperature in three stages for PEU with shorter diol chain length

2016-G20

Title: Influence of multiple reprocessing cycles on the thermal and rheological properties of PP

Author: Claudia Spicker

University: University of Wisconsin-Madison

Due to their low cost combined with their favorable properties such as low density, high strength and ease of manufacturing, plastics have replaced traditional materials in a lot of applications. Hence the consumption of plastics has increased significantly during recent years, leading to an immense amount of plastic waste. In addition to collected waste, a large amount of plastic does not reach proper disposal sites, causing a pollution of the environment and serious environmental problems. In order to make the plastic industry more sustainable, it is and will be necessary to increase the amount of recycled material. Thus, a better understanding of the effect of multiple reprocessing cycles needs to be investigated.

Single-used products, such as plastic bags, packaging and containers, cause the biggest portion of plastic waste (46% in 2011). They are mainly made out of polyolefins, in particular Polypropylene (PP) and Polyethylene (PE), leading to a high potential of recycling for these polymers. Mechanical recycling requires shredding, cleaning and re-melting of the material. During repeated reprocessing, and especially re-melting, the material properties start to degrade. This can be caused by three mechanisms: thermal degradation, mechanical degradation and thermal oxidation. The influence of these mechanisms will be separated to investigate the thermal and mechanical degradation of PP. Therefore, the melting and crystallization temperature of the reprocessed material as well as the crystallinity will be measured as a function of the reprocessing cycle. Furthermore, changes in viscosity and molecular weight will be determined after each cycle. Based on this data the impact of the different degradation mechanisms on specific properties will be evaluated.

2016-G22

Title: Mar Behavior and Damage Mechanism of Urethane-Acrylate Coatings with a Different Substrate Color

Author: Jong-Il Weon

University: Dongguk University

The effect of substrate color on the mar characteristics of urethane-acrylate coatings has been investigated. Gloss-meter and spectrophotometer are utilized to evaluate the degree of mar-induced damage of the coated surfaces. The test results show that mar resistance is superior in the order of white, red and black-colored samples. In case of black colored sample, it takes place the defuse reflection of the incident light on the damaged area, leading to whitening phenomenon. Thus, the damaged region is easily recognized by contrasting the black background. On the other hand, it is difficult for the white-colored sample to perceive the mar-damaged region by the white background, acting as protecting coloration. In addition, technical approaches leading the improvement of mar resistance of the urethane-acrylate coated surface will be discussed.

2016-G23

Title: Coupling Wave and Spectroscopic Techniques to monitor Mechanical Development of Thermosets during cure

Author: Lorenz Wruck

University: UW Madison

This work advances in measurement techniques to monitor the mechanical development of thermosets during cure. The target is to infer thermo-chemical and mechanical properties of thermosets in one experiment. A heated measurement chamber for curing thermosets, that enables the use of ultrasonic sensors and a Raman spectrometer in a single set-up, was developed. An algorithm is proposed to obtain the degree of cure evolution within the chamber using a Raman spectrometer, while the ultrasonic sensors measure the wave speed from which the modulus is inferred. The modulus and the degree of cure

can then be directly correlated from one specimen tested in a single set-up. To validate this new technique two epoxy resins are tested and the results obtained by the novel approach are compared to results from DSC and DMA measurements. This new technique is also evaluated in the context of number of tests required, amount of properties acquired, accuracy of the system and complexity of post-processing needed to interpret the data. The present results will be used in future work to layout constitutive models for the prediction of residual stresses induced during processing of thermosetting composites.

2016-G24

Title: Nonlinear Rheology of Oligomeric Ionomers: Shear-Thickening and Shear-Thinning Behavior of Sulfonated Polystyrene Melts

Author: Chongwen Huang

University: The University of Akron

Shear thickening behavior, which is often observed for associating polymer solutions, was recently reported for ionomer melts. In order to better understand the mechanism of shear thickening in these melts, the nonlinear rheological behavior of oligomeric sulfonated polystyrene ionomers (SPS) with different degrees of sulfonation and different alkali metal cations were measured at a variety of temperatures using steady shear. When the Weissenberg number, Wi , defined as the product of applied shear rate and the characteristic relaxation time of the ionic associations, approaches unity, shear thickening was observed, but only for samples with a sulfonation degree close to the gel point, which is defined when each chain has on average one ionic group. Below the gel point, only shear thinning behavior was observed, and above the gel point, melt fracture occurred. The magnitude of shear thickening increases with the decrease of temperature, molecular weight of the PS precursor and the increase of ionic strength of the metal cation, ~q/a , where q and a are the charge and radius of the cation, respectively.

2016-G25

Title: Modified Soybean Oil-Extended SBR Compounds and Vulcanizates Filled with Carbon Black and Silica

Author: Jiaxi Li

University: The University of Akron

Petroleum oil is a common plasticizer for tire rubbers filled with precipitated silica and carbon black (CB). The current trend in tire industry is to replace petroleum oils with modified oils derived from plants, such as soybean oils. The present poster describes results of studies related to utilization of soybean oil norbornylized through the reaction with dicyclopentadiene (DCPD) at various levels in SBR compounds in comparison with usage of naphthenic and unmodified soybean oil. The gel fraction, crosslink density, bound rubber fraction, curing behavior, thermal properties, mechanical and dynamic properties and the possible reactions between the SO, MSO and the silane coupling agent were investigated. Results indicated that the silica- and CB-filled SBR vulcanizates showed a similar trend on behavior of gel fraction and crosslink density for different extender oils. However, the silica-filled SBR compounds showed a lower bound rubber fraction than that of the CB-filled SBR compounds. Both silica- and CB-filled SBR compounds and vulcanizates extended with SO and MSO showed better thermal stability compared to rubbers extended with NO. The silica-filled SBR vulcanizates exhibited a higher M100, a lower tensile strength and similar abrasion resistance than those of the CB-filled SBR vulcanizates. Vulcanizates containing MSO and SO exhibited higher tensile strength and elongation at break than NO containing vulcanizates. An adjustment of the curing recipe provided the silica-filled SBR/MSO vulcanizates exhibiting lower rolling resistance, higher traction and abrasion resistance simultaneously. Usage of MSO in rubbers improves safety in manufacturing of tires.

2016-G26

Title: Production of chitosan/bacterial cellulose nanofibers by coaxial electrospinning for wound dressings

Author: Nury Ardila

University: Polytechnique Montréal

Chitosan and bacterial cellulose are two biopolymers with significant interest for wound dressing applications, owing to their antimicrobial and regenerative properties in wound healing, respectively. In this study chitosan/bacterial cellulose nanofibrous structures were obtained via coaxial electrospinning. The surface morphology of the obtained mats was analyzed via scanning electron microscopy (SEM) and transmission electron microscopy (TEM). SEM results showed that uniform fibers were obtained when a blend of chitosan (CS) and poly(ethylene oxide) (PEO) aqueous acidic solution was used in the core and a solution containing bacterial nanocellulose (BNC) in DMAc/LiCl solvent was used in the shell. Electrospun CS/PEO/BNC fibers have a diameter of 85 nm on average, and a narrow fiber size distribution. The core/shell structure was corroborated via TEM. In addition, energy-dispersive X-ray spectroscopy (EDS) analysis showed that nanofibers contained both CS and BNC along their structure. Finally, the antimicrobial properties of the mats were investigated against a non-pathogen strain of E. coli and a decrease of 99.9 % in bacterial population indicated that mats were providing a good antimicrobial activity.

Authors: Nury Ardila, Nelson Medina, Mounia Arkoun, Marie-Claude Heuzey, Abdellah Ajji, Chandra J. Panchal

2016-G27

Title: In-situ nanofiller formation in polymer nanocomposites

Author: Barbara DeButts

University: Virginia Tech

In-situ nanofiller formation in polymer nanocomposites

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Abstract

Dispersion of nanofillers in polymer nanocomposites is problematic because nanofillers prefer to agglomerate. Attempts to disperse nanofillers using extrusion require expensive processing agents, as well as high heat and shear conditions that significantly add to the cost. Despite these issues, extrusion compounding of nanofillers in polymers is the preferred method to process nanocomposites. An “in-situ polymerization” can be used to create nanocomposites, in which the nanofillers are dispersed in monomers, followed by a polymerization reaction. However, this technique is only realistic for a very limited number of polymers. Here, in-situ nanofiller formation is demonstrated where the nanofiller forms in the polymer matrix. Protein molecules are dispersed in a polymer matrix, then cooperatively self-assemble into nanostructures called amyloids. Amyloids can be considered highly “crystalline” due to high beta sheet content and therefore have the potential for high rigidity and stability. Thus, the potential to make high performance nanocomposites by in-situ nanofiller formation exists.

2016-G28

Title: Green Plastics: Utilizing Chicken Feather Keratin to Improve the Thermo-Mechanical Properties of Polyurethane Composites

Author: Firoozeh Pourjavaheri

University: RMIT University

A 'green' sustainable resource, in the form of chicken feather derived keratin, was used to enhance the thermo-mechanical properties of polyurethane bio-composites. A casting/solvent evaporation method was used to incorporate various amounts of chicken feather fibres into a polyurethane or poly(ether urethane) matrix and three levels (0, 10 and 20 20 %·w/w) of fibre composition were used. The thermo-mechanical properties of the resulting composites were then assessed using differential scanning calorimetry, thermogravimetry and dynamic mechanical analysis. The uniformity of the dispersion of the keratin fibre in the plastic matrix was investigated via photography and optical microscopy. Scanning electron microscopy was also used to verify that the adhesion between fibre and polymer was uniform. Addition of chicken feather fibres to the plastic composites was found to decrease the elastic modulus, glass transition temperature, recovery strain (%), mass loss (%) and melting temperature of the plastic composite but increase the storage modulus and char level (%). The results demonstrate that keratin derived from what is currently a waste product from the poultry industry (with significant disposal costs) can improve the thermo-mechanical properties of composites, simply and cheaply, with potentially large environmental benefits.

2016-G29

Title: Real-time Mechano-Optical Behavior and Structural Evolution of Polyimide 3,3′,4,4′- benzophenone tetracarboxylic dianhydride (BTDA) 1,6-diaminohexane (DAH) during Deformation.

Author: Ido Offenbach

University: The University of Akron

Biaxially oriented polypropylene (BOPP) has been the main material used for polymer dielectric for capacitors application. It has a low dielectric constant ~2.2, low loss factor, dielectric strength ~720[V/ μm] for films ~10 μm thick, and a self healing character. However, BOPP is limited in energy density of 5 [J/cm3] at breakdown, and reduces breakdown strength above 85°C. Therefore, development of new dielectric materials has become a popular field of research in order to fulfill the entire requirements for dielectric material. A new dielectric polymer, Polyimide(BTDA-DAH), has been synthesized. It exhibits high dielectric constants of up to 3.57 while maintaining low dissipation factors, and breakdown strength of 812 [V/μm]. Thin PI(BTDA-DAH) films can be processed by solution casting as well as melt casting. This study was performed with a one-of-a-kind instrumented system that combine real-time spectral birefringence measurements with true stress and true strain during deformation. The mechano-optical behavior of the polymer was studied in the glassy and rubbery states as functions of processing temperatures, stretching rates, and stretching ratios. As well as, the effect of stretching ratios on the PI(BTDA-DAH) dielectric properties.

2016-G30

Title: Economical Analysis of the Recycling Process of PP/LDPE Blends

Author: Raphael Kiesel

University: UW Madison-Wisconsin

For the last 40 years the amount of plastic consumed has been growing steadily, the plastic waste of both industry and private households increased as well. Consequently plastic waste handling is getting more and more important for future society. There are three ways of handling plastic waste: landfilling, combustion and recycling. From an economical point of view, recycling currently is the most expensive process, but ecologically it is and will be indispensable.

The biggest cost driver of the recycling process is the sorting of the plastic waste into its different plastic types. At present only PET can be recycled and reused nearly cost-neutral. But especially the combination of low-density polyethylene (LDPE) and polypropylene (PP) is frequently found in polymer waste streams. Due to their similar density, these two materials cannot be easily separated from each other.

Therefore it will be analyzed if the recycling of PP and LDPE compounds is economically profitable. The established and widespread PET recycling process will be extended by PP and LDPE data. Furthermore, the economical value of the recycled compound will be evaluated based on experimental obtained material and mechanical properties.

2016-G31

Title: Investigation of the Temperature Field in Fused Filament Fabrication Using Polymers with Different Thermal Conductivity

Author: Jianxing Chen

University: University of Wisconsin-Madison

Additive manufacturing has been on the rise in the past decade as “the next industrial revolution” due to its accessibility and acceleration of product development. Among the different Additive Manufacturing technologies, Fused Filament Fabrication (FFF) is the most widely used and often referred to as “3D printing”. Due to the limited adhesion between layers as well as warpage and delamination, FFF products are usually good for prototypes rather than end-user parts. Delamination can either be observed between printed layers or off the print bed. Both lead to failed prints. In order to transition from rapid prototyping to fully functional end-user products, these quality issues need to be understood and thus resolved.

There can be several reasons for warpage and delamination, including material properties, printing parameters, and non-uniform temperature while printing. This study focuses on the inhomogeneous temperature field during the print as a function of layer height, part size and material’s thermal conductivity. The latter is achieved by compounding thermal conductive fillers into the polymer matrix. By varying the three variables and analyzing the resulting temperature field with an infrared camera, a deeper understanding of the underlying principles is obtained and the basis for future simulation work is created.

2016-G32

Title: Fatty Acid Swollen Natural Rubber Shape Memory Polymers

Author: Marcos Pantoja

University: The University of Akron

Shape memory polymers (SMPs) are responsive smart materials capable of physical transformation upon the application of an external stimuli. A thermal stimulus has been the most widely used. Such SMPs consist of a permanent cross-linked polymer matrix phase embedded with a thermally reversible shape fixing network. A novel two-phase SMP formulation approach consists of swelling cross-linked natural rubber in molten stearic acid.

Fatty acid swollen natural rubber SMPs were investigated as function of swelling extents, acid polarity, and applied deformation. The fatty acid-rubber systems demonstrate a 40-50v/v% effective fatty acid solid phase loading range where the fixity of a programmed shape remained >95% while maintaining structural integrity. The strength of the crystalline fatty acid networks were determined through dynamic mechanical analysis (DMA) moduli measurements where, under large uniaxial deformations, the modulus of the fatty acid was found to increase compared to the unstrained material. This was consistent with preferential alignment of crystal platelets along the strain direction as determined by small angle X-ray scattering (SAXS) measurements. This alignment is thought to produce a lower sensitivity of the fixity on the applied strain during deformation.

2016-G33

Title: Co-polyesters of Polyethylene Terephthalate and Polyethylene 2,5-furandicarboxylate

Author: Anup Joshi

University: University of Toledo

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Title:

Development of bio-based packaging materials: Co-polyesters of Polyethylene Terephthalate (PET) and Polyethylene 2,5-furandicarboxylate (PEF)

Abstract:

Copolymerization of PET has been widely used to improve mechanical and thermal properties of base PET resin. Along with harnessing general advantages of copolymerization like improvement in glass transition temperature, reduction in crystallization rate etc.; there is considerable interest in increasing bio-based components in PET by copolymerization. In addition to development of bio based ethylene glycol (EG) and terephthalic acid (TPA), research effort has focused on incorporating other bio-based moieties in polymeric backbone of PET to modify properties. Some of the crucial challenges in incorporation of copolymers or inorganic materials in PET are tolerance limit of recycling processes for PET and impact on crystallization kinetics. By and large, incorporation of more than 10% by weight is considered unacceptable for PET recycle industry.

Upsurge in the field of biomass conversion has made economic production of furanics from non-food feedstocks feasible and opened pathway for a host of polymer systems. For example, 2,5-furandicarboxylic acid (FDCA), one of the chemicals from repertoire of furanics, has proven to be a major building block especially for polymer applications. Even though there is a promising literature

available on the synthesis and characterization of polymers based on FDCA, i.e. polyethylene furandicarboxylate (PEF), little effort has been made to address its potential use in developing co-polyesters with PET and understanding synthetic and processing challenges associated with use of these copolymers.

In this work, we report synthesis of co-polyesters of PET with 5 to 20 mole % FDCA by conventional melt polymerization technique for condensation polymerization. Structure elucidation and composition of co-polyesters was determined using Infrared Spectroscopy, Thermogravimetric Analysis and Nuclear Magnetic Resonance spectroscopy. Thermal transitions and properties were studied using Differential Scanning Calorimetry. Co-polyesters synthesized show promising thermal characteristics and have potential to be used as commercial co-polyesters of PET.

Key words:

Bio-based Packaging materials, Polyethylene furandicarboxylate (PEF), Co-polyesters of PET with FDCA.

2016-G34

Title: Processing EVOH + Nanoclay Composites with Compressed N2 and CO2

Author: Tom Ellingham

University: UW-Madison

EVOH (ethylene vinyl alcohol) was compounded with nanoclay (Cloisite 30B) in a twin screw extruder equipped with a compressed gas injection port. Two screw profiles were used; one with only forwarding elements and another with mixing, forwarding, and kneading elements. Samples with 0%, 2.5% and 5% nanoclay by weight were extruded successively through the two screw designs using no gas, CO2, or N2 at pressures just above the melt pressure (~150 psi). It was found that using the compressed gas to foam the material in the barrel and upon exiting the extruder a better dispersion of the nanofiller could be obtained, despite the gas not entering the supercritical phase.

2016-G35

Title: Open Cell Aerogel Foams

Author: Senlong Gu

University: The University of Akron

Open cell aerogel foams (OCAF) are a new class of macroscopic materials that combine the attributes of polymer foams and mesoporous aerogels in one material. OCAF have two functional elements. First, the large body of the materials are air-filled open cells with diameter greater than 1 micro-meter as in open cell foams. Second, the solid polymer films of open cell foams are replaced by polymer strands organized in the form of mesoporous (2-50 nm) aerogel films. However, synthesis of OCAF is not a straight forward task. Common foaming technologies cannot be easily adapted to obtain OCAF. The sol-gel synthesis process, unique to aerogels, involves slow chemical reactions or thermos-reversible gelation steps which cannot be combined with fast foaming processes. This paper evaluates several strategies based on the use of porogens and selective dissolution of immiscible polymer components and reaction-induced phase separation process. In one embodiment, the macropores are first created by selectively removing polymer A via dissolution from a co-continuous blend with immiscible polymer B. The gel networks of a thermoset polymer, such as polyurea or polyimide, are then synthesized inside the macropores. Finally, polymer B is removed by dissolution and the resultant material is dried under supercritical condition to yield OCAF. It is found that the gel networks are initiated by nucleation and growth mechanism on the surfaces of polymer B and gradually fills the macropores. The resultant aerogel foams exhibit bulk density less than 0.05 g/cm3, BET surface area ~ 100 m2/g, mesoporous solid networks, close to 2000% weight gain in a few seconds when exposed to liquids, and high air permeability.

2016-G37

Title: Extrusion Analysis of the Medical Catheter Tubing Having Multiple Holes

Author: Selyn Kim

University: Seoultech

Past surgeries were operated by large incision the surgical site. These surgeries have multiple drawbacks like long pain duration, profuse bleeding, slow recovery time, etc. Therefore, recently minimally invasive surgery has been widely used. The minimally invasive surgery method is a treatment method with incision only minimal site. That complements the drawbacks of the past incision surgery. Medical catheter tubing is the plastic tube used in these minimally invasive surgery. The hole in the catheter tubing is called lumen. Extrusion process for the medical catheter tubing consists of extruder, extrusion die, water bath, measuring device, take-up device, winding device, etc. In this process, the extrusion die is considered very important part to give stable flow and to determine the initial shape of catheter tubing. In this study, flows in the extrusion dies for the 2, 3, and 4-lumen tubing extrusions were observed by computer simulation. Pressure, velocity, streamline, shear rate and shear stress in the extrusion die have been examined and subsequently the flow stability has been verified.

2016-G38

Title: Deposition Strength in a FDM Type 3D Printed Specimen for Processing Temperature

Author: JungHyun Park

University: Seoul National University of Science and Technology

3D printing (AM, Additive Manufacturing) technology is being developed rapidly and many studies for 3D printing devices and 3D printing materials are being conducted. FDM (Fused Deposition Modeling) type 3D printing is the one of the additive manufacturing technology which using thermoplastic filament. The thermoplastic filament is softened and extruded through a nozzle. Softened filament is laid on the layer continuously and building a product. This FDM type 3D printing has advantages in easy operation, building big size product, and variety of material using. However, the deposition strength is inherently weak because of its process style that lay down the road of softening filament layer by layer. The deposition strength is related to process conditions such as process temperature, tool path, nozzle moving speed, and so on. The deposition strength of the product manufactured by the FDM type 3D printing is highly affected by process temperature. In this study, deposition strengths of specimens in deposition direction and orthogonal deposition direction have been analyzed for various process temperature using PLA, ABS and PA6.

2016-G39

Title: Correlation of filler orientation and shape to the thermal conductivity of plastic filament

Author: Anja Falke

University: UW Madison

3D printing is a fast growing technology for low-cost manufacturing of complex designs for rapid prototyping, tooling and other customized plastic parts. An important aspect of the growing trend of functional optimization in the 3D printing industry is the development of multi-functional materials such as thermal conductive polymers for products in the electrical industry, housings of technical devices, heat exchangers and various applications for improving the thermal management of components.

In general the thermal conductive properties of polymers are obtained by adding different shaped, highly conductive fillers, e.g., graphite or copper. The processing of filled polymers and in particular the shear rate distribution result in an orientation distribution of the fillers that causes anisotropic thermal conductive properties. Normally a disadvantage, it is an apparent advantage in 3D printing, where filaments can be oriented preferentially and thus this anisotropy can be used as a design criterion.

The research goal of this study is to investigate the effect of the filler orientation on the thermal conductivity of polymer filaments. Compounds with spherical and fibrous copper fillers are prepared using volume contents from 10-50 vol%. Both microscopy and computer tomography (µCT) are used to examine the filler shape and size as well as the distribution and orientation of the filler material in the compound, filament and part. These results are correlated to the resulting thermal conductivity in different directions using the Laser Flash method.

The opportunity of influencing the direction of the thermal conductivity by using the advantage of defining the direction of deposition individually for each printed layer will be evaluated.

2016-G40

Title: Soy Protein Isolate Films With Improved Mechanical Properties Via Bio-Based Dialdehydecarboxymethyl Cellulose Crosslinking

Author: Ting Zheng

University: Clemson University

Glycerol-plasticized soy protein isolate (SPI) films with dialdehyde carboxymethyl cellulose (DCMC) as crosslinking agent were solvent casted and tested for their mechanical properties. Results indicate that the addition of DCMC increased tensile strength (TS) up to 218%, suggesting effective crosslinking between SPI and DCMC. The significant improvements in the TS compared to other dialdehyde polysaccharide crosslinking agents such as the dialdehyde starch is due to higher compatibility of DCMC with SPI, which was confirmed by SEM imaging. Furthermore, based on stress-strain features, a hypothetical mechanism was proposed to illustrate the effect of the polymeric cross-linking agent.

2016-G41

Title: Investigation of the Anisotropy in Fused Filament Fabrication as Design Parameter

Author: Carsten Koch

University: University of Wisconsin - Madison

Fused Filament Fabrication (FFF) is among the fastest growing Additive Manufacturing technologies due to the ease of use and the vast variety of materials. The FFF process results in parts that consist of 2D layers stacked on top of each other. At the same time, the resulting 3D components exhibit extensive anisotropy of their properties. For example, the parts are much stronger in the filament direction than perpendicular to it. However, this apparent advantage (i.e., the ability to orient filaments preferentially and thus take advantage of its anisotropy) is often seen as a disadvantage due to limitations in current tool path generation tools. Understanding this anisotropy and using it as a design parameter for load-path optimized part generation would further advance FFF for end-user applications.

Therefore, the focus of this study is placed on the orientation of the filament and its effect on the mechanical properties. As a first step, the influence of print parameters such as extrusion rate and layer height on the part density is analyzed using μCT imaging. As a result theoretical calculated and measured solidities are compared and their impact on the mechanical strength studied. In a second step, the orientation of the filament is varied within the printed specimen. The effects of different solidities are then matched with the effects of different orientations. Conclusively, combining these results leads to an understanding of the correlations between orientation and crucial print parameters, which can be used as a criteria in the general design process.

2016-G44

Title: Fiber Orientation Measurements Using a Novel Image Processing Algorithm for μCT Scans

Author: Sebastian Goris

University: University of Wisconsin-Madison

Not Available

2016-G45

Title: A Cursory Exploration of Polyamide 12 / 3MTM Glass Bubble Composites Subtitle: Novel Powders for Selective Laser Sintering Applications (SLS)

Author: Lukas Duddleston

University: University of Wisconsin-Madison

This study was a cursory investigation of the mechanical properties, thermomechanical properties and the surface quality of polyamide-12/3M™ Glass Bubble composites produced by selective laser sintering (SLS). Currently, polyamide-12 (PA12) can be SLS processed to have a density of up to 95% of the bulk-processed material (i.e. injection molded). Furthermore, it has been shown that the addition of other materials to the raw polymer powder can impart improved properties. For example, compared to SLS manufactured neat (pure) PA12, glass-bead compositing can increase the Young's modulus by 70% and the temperature of deflection under load by 50%. However, this comes at the expense of increased density due to glass having a significantly higher density than PA12. The 3M™ glass bubbles investigated here as the reinforcement component have much lower densities than the currently used solid glass beads but similar composition and surface geometries. Therefore, it was anticipated that using these glass bubbles as the reinforcing component would produce composites with very similar mechanical properties to those of glass-bead-filled SLS composites but at a significantly reduced density. It was found that the bubbles improved mechanical properties and decreased the surface roughness of the printed parts.

2016-G46

Title: Micropelletization – Analysis and Applications

Author: Christian Schäfer

University: University of Wisconsin-Madison

A novel micropelletization technique yields micropellets with a controlled morphology and narrow particle size distribution which can be used for sintering applications and additive manufacturing processes such as laser sintering. A polymer melt is extruded through a capillary and the extruded thread is stretched with a hot air stream until flow instabilities cause it to breakup into small droplets. On the application side, sintered parts were produced to demonstrate possible utilization of these micropellets for industrial and commercial applications.

2016-G47

Title: Synthesis of Biobased Polyols from Soymeal and its Application in Polyurethane Rigid Foam

Author: Sayli Bote

University: Michigan State University

There is a considerable interest in the manufacture of biobased plastics using plantbiomass feedstock (e.g. Ford Motor Company's biobased PUs). At present, biobased PUs are derived from plant oil polyol. Ford uses plant oil biobased polyol at 7-15% in the manufacturing of bio-PUs for headrests and seats. There are many reports in the literature on the synthesis of polyols from biobased sources, mostly from plant oils. Since, multiple steps are involved in the manufacturing of polyols from plant oil, their cost is relatively high. Polyols derived from plant oils have been introduced into the urethane market but most of them have low hydroxyl value and secondary hydroxyl structure which is less reactive.

In this work, we have used soymeal remaining after extraction of oil from soybean for
manufacturing of biobased polyols. The soymeal was used directly without any pre-treatment for the synthesis of polyols using transamidation process. Soymeal was reacted with ethanolamine to give hydroxylamine and diamine intermediates. The parameters like time, temperature, reactants ratio and kinetics of this reaction were studied. The amine intermediates were converted to polyols by reacting them with propylene carbonate. This soymeal polyol was used to study free rise profiles of polyurethane rigid foam.

The above process can be used for any protein biomass residues (e.g. algae, DDGS). These polyamide polyols have primary as well as secondary hydroxyl group and are less susceptible to degradation by UV-light and hydrolysis than polyether or polyester polyols. Also, soymeal polyol has some primary and secondary amines which reduces amount of catalyst used for making polyurethanes. In future, we are going to study the kinetics of amines and propylene carbonate reaction, evaluate mechanical properties of rigid foam made from soymeal polyol.

2016-G48

Title: Engineering of biobased flexible polyurethane foams using a novel plant oil derived poly (ester-ether) polyol

Author: Hugh MacDowell
University: Michigan State University

Polyurethanes are class of polymers used in many applications including coatings, adhesives, elastomers, sealants and flexible and rigid foams. Sixty percent of all polyurethanes produced are for foam applications. Current polyurethane chemistries utilize only unsustainable petroleum derived molecules, leading to a motivation to develop biobased substitutes. Polyurethane foam is synthesized by mixing polyols, isocyanate, and other additives. Polyol constituents of the foam can be readily synthesized using biobased components. A biobased polyol was created by reacting dimerized fatty acid with polyethylene glycol by condensation reaction. The biobased polyol produced was mixed in various ratios of 35%, 40%, 45%, and 50% with existing petroleum based polyols to produce flexible foam. The foam produced was found to have comparable properties to the existing technology while decreasing the use of petroleum.

UNDERGRADUATE STUDENT POSTERS

2016-U01

Title: Bioepoxy Foaming Using Polymethylhydrosiloxane

Author: Nathaniel Brown

University: Clemson University

The Corporate Average Fuel Economy (CAFE) standards mandate that cars and light trucks have a fuel economy of at least 54.5 MPG by 2025 in an effort to eliminate 6 billion tons of cumulative CO2 emissions. This directive has spurred the automotive industry to focus on a variety of options. Among these are lightweight structural polymeric foams, which offer tailor-made solutions for significant weight reduction while not compromising on safety. However, most structural foams are petroleum-based, thereby contributing to the depletion of non-renewable petroleum resources. Biopolymers, such as those from non-food based sources, offer a more environmentally-responsible alternative.

In this study, the effect of polymethylhydrosiloxane (PMHS) as a foaming agent on the properties of pine oil-based epoxy was investigated. The resulting materials were then tested for their compression properties, density, and microstructure.

2016-U02

Title: Antimicrobial effect of ion charged polymers

Author: Robert Josman

University: Bronx Community College of CUNY

The exponential increase in antibiotic resistant bacteria has created an urgency for this research, not only in reducing the expansion of medical costs, but also to provide better patient outcomes. The Surlyn® ionomers are ethylene methacryclic acid copolymers that are ion charged particles of potassium and sodium instead of silver. Silver has raised some concerns that it has migratory effects. This research examines the effects of thin-film plastic copolymers with varying concentrations of sodium and potassium ions. These materials were then assessed against two separate genus of bacteria cultivated in broth and exposed to wells coated with the films. These samples were compared against a control containing no ions.

2016-U03

Title: Finite Element Simulation of the Selective Laser Sintering Process

Author: Aevyrie Roessler

University: University of Wisconsin - Madison

Selective Laser Sintering is an additive manufacturing process that builds up plastic parts by sintering layers of semi-crystalline polymer powder one layer at a time using a laser. Due to non-uniform crystallization, internal stresses form in parts as they cool, which can lead to undesirable effects such as edges of flat sheets curling inward. The goal of this simulation is to predict this deformation by modeling heat transfer from the laser as well as the resulting crystallization and internal stresses in a part. This will allow engineers to eventually use the software to predict the necessary initial geometry that will result in the desired geometry after cooling and deforming. The simulation is written in MATLAB® using the Finite Element Method (FEM) in 2D to find the transient temperature distribution, which is then used to determine percent crystallinity. Simulation results have been found to match expected crystallization behavior, with future work needed to compute stresses.

2016-U04

Title: Using Infrared Temperature Sensors to Study Temperature Change of PVC During Flow with the Incorporation of Melt Rotation Techology

Author: Stacey Johnson

University: Penn State Erie

Infrared temperature sensors were used to study the effect of mold rotation technology on the plastic melt temperature and shear-burning that commonly occurs with PVC. Inserts were designed and built so that areas of high shear could be introduced during flow through a runner, as well as provide for the incorporation of melt rotation technology. A DOE was used to investigate how factors such as melt temperature, residence time, injection rate, and packing rate affected the temperature at various points along the flow path. It was found that the use of melt rotation technology could allow more uniform temperatures after the point of rotation without causing a larger problem with shear-burning.

2016-U05

Title: Reverse Engineered Protogami Hexagonal Kaleidocycle

Author: Jason Suess

University: Penn State Behrend

This kaleidocycle assembly consists of six components, two components with three copies each, linked together to form a geometric work of art. It has been redesigned to simplify complex geometry and mold construction. The purpose of the kaleidocycle is to attract attention through intrigue and wonderment; to be handed out as a souvenir. With the help from Creo and Moldflow software, an existing kaleidocycle component was redesigned. Creo assisted in the construction of virtual part and mold geometry and Moldflow was used to simulate various gating options. The redesigned part is much less complex and significantly simplifies mold construction.

2016-U06

Title: The effect of thermal and frequency loading on PEEK mechanical properties

Author: Rebecca Wheeler

University: Penn State Behrend

Poly (ether ether ketone) (PEEK) is a high performance polymer that has high elastic modulus, high melting temperature, high toughness, and wear resistant properties. Data sheet properties are commonly used to inform product design, but these data points are obtained under optimal, simplistic conditions. The long term material properties of PEEK have been evaluated in order to explore the effect of thermal cycling above and below the glass transition temperature while under a static load and frequency cycling at 1 Hz and 100 Hz. Samples were injection molded with and without center weld lines to investigate the influence of the preconditioning on weld line properties.

2016-U07

Title: Rapid Crystallization Temperature of PEEK in an Injection Molding Process

Author: Kyle Radack

University: Penn State Erie - The Behrend College

Crystallinity in thermoplastics can vary significantly based on variables in an injection molding process. A major factor driving this variation is mold temperature. Semi-crystalline polymers have a specific temperature in which the rate of crystallization is maximized. Maximum crystallinity can be achieved by optimizing mold temperature in order to hold the polymer at this rapid crystallization temperature. An experiment was performed using injection molded PEEK to find its rapid crystallization temperature and this maximum was determined to be 220^{o}C. Above and below this temperature the polymer chains have either too much energy or not enough to form crystals efficiently and the crystallization process slows. Samples were then molded under conditions designed to hold the polymer at 220^{o}C. Mechanical tests were completed to understand the relationship of tensile modulus with the rapid crystallization temperature of the PEEK polymer.

2016-U08

Title: Design of a Disposable High Pressure Resin Hopper

Author: Angela DeAngelo

University: Penn State Erie, The Behrend College

This experiment is focused on designing a disposable, inexpensive and translucent one time use resin hopper for silicone like materials that is capable of withstanding 0.517-0.689 mPa. The focus of this study was on simulating the stresses polypropylene and polycarbonate would be exposed to under the given processing conditions. Multiple tests using ANSYS software to determine the thinnest wall thickness of the part able to be used without walls of the resin hopper failing and simulating the stresses of the silicone injection process were conducted on the part. Results of the ANSYS studies showed that the mechanical properties and dimensional stability of both polypropylene and polycarbonate remain relatively consistent and may be used as the replacement material to reduce production costs for the disposable resin hopper.

2016-U09

Title: Investigating Creation of Reformable Bridge Structures Through Processing Ternary Systems

Author: Kendal Clouse

University: Penn State Erie, The Behrend College

Typically fiber fillers used in polymers experience some degree of breakage during processing. If a filler had the ability to break down during processing but reform post processing, the effects of breakage in a filled material could be avoided. This would also be environmentally pleasing as the filled material could be recycled without loss of mechanical properties. Through continuous research and collaboration with the University of Pittsburgh's Chemical Engineering Department, research on ternary polymer systems containing two immiscible polymers and one solid filler is being performed to determine if this reformable filler can be created. Low and high molecular weight systems have been produced and observed to determine if high-aspect ratio filler like structures called pendular networks can form based on the chosen materials. The preliminary work on low molecular weight systems has been promising and work is currently being conducted on higher molecular weight systems to see if these findings can be duplicated in easily processable materials.

2016-U10

Title: Abstract

Author: Mitchell Garus

University: Penn State Behrend

Not Available

2016-U11

Title: Comparison of Optimization of Velocity Methodologies

Author: Kevin Orndorf

University: Penn State university

Optimum injection velocity or fill time is one of the most important process parameters that must be determined when setting up a 2-stage or 3-stage process. This experiment focuses of testing and comparing the two most widely used methods of determining optimum velocity to delineate which is the most effective and practical to use when establishing a process. In completion of the study both yielded useful results, while one allowed for easier detection of variation in the process and material.

2016-U12

Title: Determining Impact Properties of Biofillers

Author: Kate Pellett

University: Penn State Behrend

The purpose of this research study was identifying the effects uncirculated currency and wheat straw had on the impact properties of compression molded phenolic plates. These materials are biofillers which are used in the plastics industry in an effort to be more environmentally conscious. These biofillers however may not effect material properties in the same way that a standard filler would. The effects it has on impact properties are tested using the Gardner impact method. It was found that the biofillers, wheat and currency, reduced the impact properties of phenolic.

2016-U15

Title: Thermal Conductivity of PEEK/BN Composites in an Injection Molded Process

Author: Glenn Spiering

University: Penn State Erie, the Behrend College

Composites of poly(etheretherketone) (PEEK) and boron nitride (BN) have been tested to determine their thermal conductivity. BN is a ceramic with high thermal conductivity, and PEEK is a thermoplastic that demonstrates common polymer insulating properties. A silane coupling agent was introduced to improve the bond between the PEEK and BN. Multiple loading levels of the BN were studies to determine the effects the amount filler has on composite thermal conductivity. Samples were prepared by twin screw extrusion compounding followed by injection molding, resulting in BN particles aligned in the direction of the polymer flow. Thermal conductivity both parallel and perpendicular to filler orientation were tested to analyze directional effects caused by molding orientation. Perpendicular to the orientation of the BN filler, the composite exhibited little change in thermal conductivity with increasing BN loading. Increases in the filler loading increased the thermal conductivity of the composite in the orientation parallel to the BN filler up to 1200% at the maximum filler loading level of 40% BN by mass.

2016-U16

Title: Silicon injection over molding polycarbonate coasters

Author: Dalton Zelasco

University: Penn State Erie, The Behrend College

In this design project, A mold insert was to be designed to over-mold Liquid Silicon Rubber (LSR) onto a pre-existing polycarbonate drink coaster. The polycarbonate coaster was redesigned and used to create a new model of the final over-molded product. This final part model was then used to design a mold insert complete with an optimized parting line, appropriate core pins, and ejection capabilities.

2016-U17

Title: Improving Hydrolysis Resistance in Thermoplastics

Author: Michael Beeler

University: UW-Stout

This research involves improving hydrolysis resistance of thermoplastics. Two base resins were utilized to compound various batches of material, each with different amounts of individual additives using a twin screw extruder. Base material and compounded material were then injection molded into tensile bars and were sent to get hydrolytically aged. Once aged, characterization of the tensile bars will be conducted using tensile testing, flexural testing, and melt flow index.

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2016-U18

Title: Thermal and Mechanical Properties of Epoxidized Pine Oil and Acrylated Epoxidized Soybean Oil Blends

Author: Mario Krussig

University:

Synthetic polymers derived from crude oil are widely used across various industries. However, increased environmental regulations tackling climate change have spurred interest in development of bio-sourced polymers. While promoting the cause of sustainability, biopolymers also possess inferior mechanical properties, limiting their widespread use. A plausible and cost-effective way of enhancing the properties of pure biopolymers is to blend them with other polymers and/or reinforce them with stiff fibers. This study investigates the thermophysical properties of bio-based thermoset blends of epoxidized pine oil (EPO) and acrylated epoxidized soybean oil (AESO). The blends were prepared via casting in five different ratios by volume (EPO/AESO): 100/0, 90/10, 80/20, 70/30, and 0/100. Mechanical properties of blends were studied via tensile testing and scanning electron microscopy, while chemical properties were analyzed using thermo-gravimetric analysis.

2016-U19

Title: Advanced Composite Reinforcement and Matrix Impact/Tensile Testing

Author: Jordan Greenland

University: Penn College of Technology

When multiple materials are combined together to produce an entirely new composite material with unique mechanical properties. The combination of different reinforcements, matrice, and cores cause varying mechanical properties within the completed composite.

Composite adhesion, modulus, and impact strength are the focus of the mechanical property data collected and observed.

2016-U20

Title: Advance Composites for a Cruiser Long Board

Author: Rebecca Brown

University: Pennsylvania College of Technology

The purpose of this project was to create two different composite materials that are lightweight and durable using two different types of core materials: balsa wood and foam. Conclusions are made to which core material provides the highest strength appropriate rigidity as is of interest for making cruiser long boards.

2016-U21

Title: Feasibility Study of 3D Printed Inserts for Rotational Molding

Author: Logan Tate

University: Pennsylvania College of Technology

The purpose of this project was to explore the feasibility of using 3D printed inserts for rotational molding. The goal was to achieve a finished product with a 3D printed insert adhered to the surface. In the future, we will repeat this experiment using a variety of 3D printed resins to compare the integrity of these attachments to standard rotational molding inserts.

2016-U24

Title: Evaluation of Injection Molding Switchover Methods and Compression Control of Priamus Control P

Author: Gavin Borchardt

University: UW-Stout

Co-Authors: Gavin Borchardt and Daniel Larsen

The scope of this project involves the evaluation of injection molding switchover methods and the compression control of Priamus Control P. First, the effectiveness of switchover methods was evaluated with respect to part quality. Switchover by screw position, cavity pressure, and melt front detection were evaluated by imposing a change in material viscosity and measuring the change in part weight and overall part length. The evaluation of switchover methods is related to Priamus Control P because Control P uses switchover by melt front detection. Through the evaluation of switchover methods, Control P is being evaluated as well. Beyond the evaluation of switchover methods, another aspect of Control P will be evaluated. The compression control of Priamus Control P will also be evaluated in the same way as the switchover methods. A change in viscosity will be imposed on the material and the difference in part weight and overall length will be measured and used to determine the effectiveness of Control P. Initial results indicate that melt front detection switchover showed the smallest change in part size followed by screw position switchover and finally the cavity pressure switchover. The compression control module has not been utilized at this point in time.

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2016-U25

Title: Rapid Prototyping: Production of ABS Printing Filament

Author: Logan Larson

University: UW-Stout

This research involves the production of 3D print filament for fused deposition modeling (FDM) through a variety of production methods and equipment. The filament produced was compared to filament purchased from Push Plastic, 3D Artist Supply, and Stratasys. The factors compared included cost, Melt Flow Index (MFI) and dimensional analysis. The goal will be to create high quality 3D printing filament that is also low cost. The two extruders used for these experiments will be an industrial grade twin screw extruder and a kit extruder to determine the overhead cost to produce high quality filament for rapid prototyping.

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