Symposium 10

Polymer Alloys and Blends

S10-195

Thermoplastic Polyolefin Nanocomposites for Automotive Applications

Paul Donald R. [1], Kim Do Hoon [1], Rodgers William R. [2], Fasulo Paula D. [2]

[1] University of Texas at Austin - Texas - USA, [2] General Motors R & D Center - Michigan - USA
drp@che.utexas.edu

Thermoplastic polyolefins (TPO) filled with talc are frequently used for numerous automotive parts. Replacement of the talc filler with organoclays has emerged as an attractive option. Fillers are added to TPOs to achieve increased stiffness and reduced coefficients of thermal expansion. Typically, 20 to 40% by weight of talc may be needed to reach the property goals; however, these same levels of performance can often be met with nearly an order of magnitude less of a montmorillonite-based organoclay. This results in a significant reduction in weight because of the reduced amount of inorganic material, an improved surface finish because of the smaller filler particle size, and improved processing characteristics (e.g., faster mold fill) owing to the lower volume fraction of filler. This presentation will address the issues of formulating such TPO nanocomposites emphasizing the relationship between mechanical/thermal properties and the morphology of the nanocomposites. A key to achieving exfoliation of the organoclay in the polypropylene matrix of the TPO is to select the organoclay with an optimal structure (surface modification chemistry) and to add a small amount of polypropylene that has been grafted with maleic anhydride (PP-g-MA). The content of PP-g-MA affects the morphology of the nanocomposite and, thus, its properties. The composite morphology was determined by forming images by transmission electron microscopy (TEM) to see the clay particles and by atomic force microscopy (AFM) to see the elastomer particles. These images were quantitatively analyzed to determine the average size and shape of the two kinds of particles (clay and elastomer) and how one type of particle affects the size and shape of the other. Mechanical properties and thermal expansion behavior were determined as a function of the formulation variables and then related to the morphology within the frame of composite theories.

S10-603

Effects of confinement and component viscoelasticity on single droplet behavior during shear flow

Cardinaels Ruth [1], Vananroye Anja [1], Verhulst Kristof [1], Moldenaers Paula [1]

[1] K.U.Leuven - Leuven - Belgium
paula.moldenaers@cit.kuleuven.be

Blending of polymers offers a way to tailor the properties of a material without investing in new chemistry. The final mechanical properties of blend however, depend largely on the morphology. Commonly, during processing droplet-matrix structures are generated by a combination of deformation, breakup and coalescence. For blends composed of Newtonian components, subjected to bulk shear flow, models are available to predict the morphology. However, to model industrial polymer processing, additional research is needed. Primarily, industrially relevant components are viscoelastic. A second aspect which is generally disregarded in the existing models is the fact that in complex processing equipment with highly concentrated bends and small passages, the effects of the walls on the droplet dynamics can not a priori be excluded. In addition, microfluidic devices are becoming common practice in industry. In this work, we present a systematical study on the separate and combined influence of confinement and component viscoelasticity on the behavior of single droplets in shear flow. Experiments are performed with a counter rotating plate-plate device, combined with a microscopy setup, enabling 3D visualization of droplets. It is shown that viscoelasticity of the matrix can substantially reduce the droplet deformation, an effect which saturates at high De-numbers. The influence of droplet viscoelasticity on the other hand is more limited. Confinement acts to increase the droplet deformation and its orientation towards the flow direction, to an extent depending on component viscoelasticity and viscosity ratio. At high flow intensities, both droplet viscoelasticity and confinement induce oscillations in the droplet shape during startup of flow. For blends containing a viscoelastic component, a profound influence of the shear flow history on the droplet stability is discovered. Also confinement offers a way to suppress or promote droplet breakup, depending on the conditions.

S10-713

Biomimetic polymers through functionalisation and blending

Ciardelli Gianluca [1], Gentile Piergiorgio [1], Sartori Susanna [2], Rechichi Alfonsina [1], Vozzi Giovanni [2], Chiono Valeria [1]

[1] Politecnico di Torino - - - Italy, [2] University of Pisa - - - Pisa
gianluca.ciardelli@polito.it

Tissue engineering is an interdisciplinary research area which investigates the combined use of cells, biomaterials, and micro-environmental factors to promote tissue repair and/or functional restoration. The current trend is the obtainment of biomimetic scaffolds, able to provide the necessary signalling for cell attachment, proliferation and differentiation by mimicking the extracellular matrix (ECM). Biomimetic materials can be obtained by the incorporation of biomolecules taking part in specific interactions with cell receptors - such as components of the ECM or cell-binding peptides (derived from intact ECM proteins) - via chemical or physical modification of biocompatible synthetic polymers. Surface modification involves grafting of proteins and/or specific peptides enhancing the substrate cell, blood or tissue compatibility, via enzymatic or chemical approaches. On the other hand, physical modification of synthetic polymers may be achieved through blending with a natural polymer (protein or polysaccharide), which peptide sequences or carbohydrate moieties are components of the ECM and may interact with cell receptors. As synthetic starting materials, we used novel synthesised segmented polyurethanes (PUs) and a commercial poly-(ε-caprolactone) (PCL). Both polymers have good mechanical properties, processability and biocompatibility. Substrates for tissue regeneration were obtained by grafting Arg-Gly-Asp (RGD) containing peptides on novel synthesised PUs by Argon plasma technique. Binary blends having a synthetic polymer (PCL), as the major component and a natural polymer (gelatine (G), starch (S) or chitosan (CS)), as the dispersed phase were produced through solution or melt-mixing and then shaped into scaffolds by both conventional (e.g. melt-extrusion) and rapid prototyping techniques (e.g. selective laser sintering). Both strategies for the production of biomimetic scaffolds and substrate characterisation are here presented.

S10-1306

Melt mixed blends of polycarbonate and polyamide with multiwalled carbon nanotube concentrates in polyethylene

Pötschke Petra [1], Pegel Sven [1], Claes Michael [2], Bonduel Daniel [2]

[1] Leibniz Institute of Polymer Research Dresden - Dresden - Germany, [2] Nanocyl S.A. - Sambreville - Belgium
poe@ipfdd.de

In context with industrial applications of carbon nanotubes (CNT) in melt mixed composites improvement of the CNT dispersion is an important issue and sometimes difficult to achieve. On the other hand, there are methods to synthesize polymer chains directly at the surface of nanofillers, like CNT, thus, realising excellent wetting of the tubes by polymer, separation of the tubes, and excellent dispersion in such concentrates. Recently, Nanocyl S.A. developed the Nanocyl®-9000 series representing such a unique additive that contains very high loading (up to 45 wt%) of CNT already predispersed in a high density polyethylene carrier (PE). This predispersion is achieved by in situ polymerization of ethylene as catalyzed directly from the nanotube surface which was treated with a metallocene-based complex.Such concentrates of PE with multiwalled carbon nanotubes (MWNT) having 24-44 wt% MWNT were incorporated into matrix polymers which are highly immiscible with PE, like polycarbonate (PC) and polyamide (PA6). The melt mixing was performed using a DACA microcompounder in 4 g scale. By this, blend structures consisting of base polymer matrix and small polyethylene dispersed particles were formed in which the MWNT are found to be in majority migrated into the matrix material. The distribution of nanotubes within the polymer material is very homogeneous and the dispersion is excellent, consisting of mainly single tubes. This migration of the MWNT can be assigned to much more favorable interactions between nanotubes and PA6 or PC (lower interfacial energies) than between nanotubes and PE (higher interfacial energy).As a result, in these blend composites the electrical percolation concentration was shifted to lower values as compared to samples with direct MWNT addition. Electrical percolation concentration was found as low as 0.25 wt% MWNT in polycarbonate, whereas for pure nanotube material having the same structural characteristic it occurred at 0.75 wt%.

S10-135

A New Class of Selectively Crosslinked Polyolefin Blends

Gahleitner Markus [1], Machl Doris [1], Pham Tung [1]

[1] Borealis Polyolefine GmbH - Linz, OOE - Austria
markus.gahleitner@borealisgroup.com

For achieving highest toughness and impact strength of propylene polymers in a wide temperature range, the addition of elastomeric or generally soft components in the form of disperse particles in the µm-range is commonly applied. As these particles are subjected to deformation and agglomeration in processing, often resulting in massive changes of the final mechanical behavior and surface appearance, various attempts have been made in the past to avoid this by crosslinking the soft / elastomeric phase. In a brief overview of literature in the field the problems associated to the lack of selectivity of the various crosslinking systems – especially the use of radical reactions – will be demonstrated. A novel concept was now developed, based on dispersing an ethylene polymer with silanol groups in a propylene polymer matrix, followed by selective hydrolytic crosslinking of the disperse phase. The thus obtained compositions remain thermoplastic up to 50% of crosslinked PE phase, while they also retain the heat resistance of the PP matrix to a large extent due to a shift in phase inversion. High impact strength levels can be combined with excellent processability and surface quality by varying components and composition of these blends. Viscosity ratio effects, crosslinking history and the mechanical performance of this new class of thermoplastic elastomers, which may well qualify for a wide range of technically demanding applications.

S10-150

Recent Advances on the Use Halogen-Free Modifiers as Fire Retardant Additives in Polyester Resins Applications

KICKO-WALCZAK Ewa [1]

[1] ICRI - Warszawa - Poland
ewa.kicko-walczak@ichp.pl

Boron compounds share several chemical functionalities with account for a number of highly diversified chemical reaction possibilities. This is reason why borates based products are considered to be multi useful in ceramics, anti-corrosion products and flame retardant applications for rubber and cellulosic products [l, 2]. In recent years, the use of boron compounds such as zinc borate, ammonium borate, calcium borate and other metalloborates as fire retardants (FR) m the polimeric industry has become prominent [3],[4, 5]. This paper addresses some examples of borates and modified borates compounds and chemical, physical properties, and use applications of borates in unsaturated polyester resins and some thermoplastics materials.The flame retardancy and thermal stabilisation of halogenated and halogen-free polyester resins by borates / modifield borates has been investigated by Oxygen Index (0I) analysis and by termogravimetry (TG) in both dynamic and isothermal mode.Evaluation of the thermal decomposition and smoke generated during flaming combustion has been carried by using Cone Calorimeter method.Among all, of the boron-containing fire retardants, zinc borate, melamine borate and ammonium pentaborate are of the most commercial importance in the polyester resins industry.Borates as fire retardants are finding increasing use in halogen-free polyester systems. Emphasis will be on developments in the use of borates as multifunctional FR in electrical/electronic, transportation and building polyester applications. GRP laminates with these polymers meet fire-safety recommendations concerning smoke evolution from materials used in transportation means and in the building industry. References: 1.Kirk-Othmer Encyclopeadia of Chemical Technology, 1992, John WUey a. S. 2.Ferm D. J., Shen K. K.: Proceeding Intern. Conf. on Thermal Insulation, 311, (1994). 3.Shen K. K.: Plastics Compounding 1988 4.Leeuwendal R.: Addcon World'98 Conference 1998, paper

S10-171

Use of Lithium-Neutralized Ethylene/Methacrylic Acid Copolymer Ionomers as Blend Compatibilizers for Nylon 6 and Low-Density Polyethylene

Sinthavathavorn Wachiraphon [1], Magaraphan Rathanawan [1], Nithitanakul Manit [1], Grady Brain P [2]

[1] Petroleum and Petrochemical College - Bangkok - Thailand, [2] University of Oklahoma - Oklahoma - USA
rathana.k@chula.ac.th

Blends of polyamide 6 with low-density polyethylene compatibilized lithium-neutralized with ethylene-methacrylic acid ionomers were investigated at 11, 33, 55 wt% neutralization of ionomer. Blends of polyamide 6 with low-density polyethylene without compatibilizer had poor properties characteristic of incompatible polymer-polymer blends. After adding compatibilizer, tensile properties improved, the modulus drop associated with melting increased to higher temperatures, real shear viscosity incresead and the dispersed phase size decreased. The improvement of mechanical properties and thermomechanical properties is less with EMAA than with ionomers.

S10-175

Thermomechanical and morphological investigation of iPP / SGFR (30 wt %) PA-66 Blends-composites using isotactic poly (propylene) – graft-maleic anhydride as compatibilizer

Zitouni Safidine - [1], Said Fellahi - [2], Hans Joachim Radusch - [3], Djafar Benachour - [4]

[1] military polytechnic school - Macromolecular Chemistry, Bordj El Bahri City Algiers, 16000 - Algeria, [2] - Rubbers and Plastics Department, IAP Boumerdès - Algeria, [3] Martin - Luther University Halle Wittenberg D 06099 Halle Saale - Germany, [4] Polymer - technology Department FA UniversitySetif 19000 - Algeria
safi192003@yahoo.fr

Isotactic poly (propylene)/ Isotactic Poly (propylene)-graft-maleic anhydride /short Glass Fiber Reinforced Polyamide 66 (IPP/PP-g-MAH/SGFR PA 66) Blends-composites were investigated with and without the addition of Poly (propylene)-graft-maleic anhydride (PP-g-MAH) as a compatibilizer. The effect of this later on the thermal properties and mechanical behavior was determined by differential scanning calorimetry (DSC 820e Metler Toledo), TGA and conventional mechanical testing. The morphological investigation was carried out by the use of SEM observation and polarized light microscopy. From the results it is found that the PP as the minor part in these blends is significantly affect by the presence of PP-g-MAH. In these blends-composites, the optimal amount of compatibilizer is found equal to 2.5 wt % which the all properties level off. The nucleating effect of glass fiber is reveled when comparing the reinforced blends and non reinforced blends. The crystallization behavior was not affected for SGFR PA 66 as a major part even though the amount of compatibilizer was high. Key words: polypropylene, Polyamide 66, Polypropylene-polyamide blends, Glass Fiber, compatibiliser, mechanical properties, DSC, TGA, OM, SEM.

S10-192

Coalescence of partially miscible polymer blends in a confined flow

Tufano Carmela [1], Peters Gerrit W.M. [1], Meijer Han E.H. [1]

[1] *Eindhoven University of Technology - The Netherlands - The Netherlands*
c.tufano@tue.nl

The influence of a confinement on the steady state morphology of two different emulsions was investigated. The blends are made of Polybutene (PB, Indopol H-25, BP Chemicals; Mn=635) in Polydimethylsiloxane (PDMS, UCT; Mn=62700), and Polybutadiene (PBD, Ricon 134, Sartomer; Mn=8000) in PDMS. The viscosity ratios (viscosity of drop over matrix) are 1.2 for the PBD/PDMS system, and 0.3 for the PB/PDMS system. The interfacial tension measurements at room temperature, show that the PBD/PDMS system is slightly diffusive, while the PB/PDMS system is highly diffusive. Given the long shearing time needed to achieve a steady-state morphology, we refer to the steady interfacial tension values, which are 4.2 mN/m and 2.2 mN/m, respectively. The samples were sheared between two parallel plates, mostly with a gap spacing of 40µm, in the range of shear rates at which the transition from ""bulk"" towards ""confined"" behavior was observed. The influence of concentration and shear rate on the final steady state morphologies were systematically investigated. By decreasing the shear rate, it was found that droplets arrange themselves into two layers. When the degree of confinement reached a critical value, a single layer of droplets was formed. The ratio between the drop diameters and the gap spacing at which this transition occurred was always lower than 0.5. While decreasing the shear rate, the degree of confinement increases due to drop coalescence. Droplets arranged themselves in superstructures like ordered pearl necklaces and, at even lower shear rates, strings. The aspect ratio and width of the droplets were compared to the prediction of the Maffettone-Minale model. This theory, derived for unconfined shear flow, is not able to fully predict the drop deformation in confined geometries. The partially mobile interface model succeeded to predict the average drop size except for the cases in which the diameter of the droplets was limited by the degree of confinement.

S10-250

Relationship Between Morphology and Melt Linear Viscoelastic Properties of (PA6/PP/PS) Ternary blend Systems

Mohammadigoushki Hadi [1], Nazockdast Hossein [1]

[1] *Amirkabir University of Technology - Tehran - Iran*
nazdast@aut.ac.ir

An attempt was made in the present work to predict the morphology development of ternary blends by using dynamic interfacial tension evaluated based on Palierne model in conjuction with spreading coefficient concept. The morphology developmentand and linear melt viscoelastic behavior of (PA6/PP/PS) ternary blend samples with the same composition (70/15/15) were studied by using SEM and linear melt viscoelastic measurments. The (PA6/PP/PS) ternary blend samples were prepared by melt blending in an internal mixer at 260°C and 60rpm of rotor speed. A pronounced viscosity upturn and nonterminal behavior in storage modulus at low frequency range were observed for the ternary blend samples. This behavior was an indication of a strong interfacial interaction between the blend components. The results predicted by spreading coefficient approach were suggested a core-shell type morphology, in which PP was encapsulated by PS phase as a composite minor phase dispersed in PA6 matrix. This was evidenced by morphological results obtained by SEM. It was demonstrated that there is a close relationship between melt viscoelastic properties and morphology of ternary blends. Keywords: Rheology; Interfacial Tension; Core-Shell Morphology; Ternary blends

S10-280

Mechanical properties and processability for binary blends of metallocene PP and metallocene LLDPE

Ono Kazuya [1], Ogita Hiroaki [1], Yamaguchi Masayuki [2]

[1] Nihon Tetra Pak K.K. - Shizuoka - Japan, [2] Japan Advanced Institute of Science and Technology - Ishikawa - Japan
kazuya.ono@tetrapak.com

Polymer blend is a practical method to improve processaiblity or to obtain preferable material properties when any of neat polymers are not sufficient for the purpose. It requires blending polymers with different nature such as polar and non-polar polymer to achieve expected quality so that compatibilizer is sometimes combined for fine dispersion. Blending of polyethylene and polypropylene is seemingly facile procedure without any compatibilizers as both components are polyolefin. In actual processing, however, it is difficult to obtain a compatible compound despite of the similarity of chemical property. One of reported facts was that specific ethylene-a-olefin copolymers are only miscible to isotactic polypropylene, but not to syndiotactic polypropylene. Another report indicates that metallocene polyethylene is better than Ziegler-Natta polyethylene to blend with polypropylene. In this study, extrusion porcessability of metallocene polypropylene random copolymer (mPP) was improved by blending of metallocene linear low density polyethylene (mLLDPE) for extrusion coating. The mechanical properties of the extruded film were also evaluated. It is found that the processability is improved by blending 20 weigh % of mLLDPE in an extruder. The tensile strength of the extruded film in machine direction was also improved by blending of mLLDPE up to 20 weight %, while it was proportional to blend ratio in transversal direction.

S10-421

Crystallization of PBT/PET blends under low and high cooling rates: thermodynamics and kinetics considerations

La Carrubba Vincenzo [1], Piccarolo Stefano [1], Brucato Valerio [1]

[1] Università di Palermo - Palermo - Italy
lacarrubba@dicpm.unipa.it

In recent years large attention has been paid to the development of high-performance polyesters blends, among which PBT/PET blend are expected to exhibit remarkable properties as far as the crystallization behaviour is concerned. The solidification behaviour of several PBT/PET blends (90/10, 72/25, 60/40 w/w) was studied in a broad range of cooling conditions, according to a Continuous Cooling Transformation (CCT) procedure developed by the authors, aiming to emulate the typical conditions encountered in polymer processing. The solidification and melting behaviour under mild conditions (up to 2-3 °C/s) was extensively studied by Differential Scanning Calorimetry (DSC). As for larger cooling rates, a set of thin films (100-200 μm thick) characterized by an homogeneous structure was prepared by solidification from the melt through spray cooling, and the resulting structure and properties were post-mortem evaluated by means of density, Micro Hardness (MH), Wide Angle X-ray Diffraction (WAXD) measurements, in order to describe their dependence upon the imposed thermal history (cooling rate) and the chemical composition. Results show that for all the blends (90/10, 75/25, 60/40 PBT/PET w/w), density values lie in between those of the two constituents, as well as the density drop location; furthermore, all the blends behave like a "pure material", exhibiting only one density drop, located around 50°C/s irrespectively of the relative PET content.

S10-445

Development of New Polypropylene Based Blends for Laser Sintering

Fiedler Lothar [1], Haehndel Andreas [1], Wutzler André [2], Gerken Joerg [3], Radusch Hans-Joachim [1]

[1] Martin Luther University Halle-Wittenberg - Sachsen-Anhalt - Germany, [2] Polymer Service GmbH Merseburg - Sachsen-Anhalt - Germany, [3] rpm rapid product manufacturing GmbH Helmstedt - Niedersachsen - Germany
lothar.fiedler@iw.uni-halle.de

In comparison to polyamide (PA) the application of polypropylene (PP) for laser sintering did not lead to satisfying results until now in practice. In recent works the authors evaluated the properties of PP being essential for the laser sintering processability. For this purpose thermal and rheological analysis, FTIR spectroscopy, and granulometric experiments were performed. The majority of the PP investigated turned out to be potential materials for laser sintering, but there were still shortcomings regarding the crystallization behavior of the melt, the toughness of the materials and the shrinkage and warpage behavior during the sintering process. In the result of the investigation a strategy for materials modification of PP grades for adapting to the laser sintering technology has been developed. Blends of PP with different copolymers were produced, mechanically and thermally characterized, and finally sintered. The changes of the materials properties are discussed in connection to the laser sinter process. The optimized blends provide the opportunity to produce laser sintered parts with good mechanical properties and adequate accuracy.

S10-614

In-situ visualization of drop deformation under simple shear flow

Mechbal Nizar [1], Bousmina Mosto [1]

[1] Laval University - Québec - Canada
nizar.mechbal.1@ulaval.ca

The deformation and critical break up conditions of a liquid drop immersed in a liquid matrix are studied under shear conditions for different viscosity ratios. In-situ visualization experiments were conducted using a transparent Couette cell that was incorporated to the Paar Physica MCR500 shear rheometer. The effect of drop or matrix elasticity was tested and was found to play a major role in both deformation process and break up. The results show that Newtonian drops stretch monotonically till steady deformation or break up is achieved, whereas viscoelastic drops may stretch and wobble before reaching a steady deformation. Experimental results were compared to Jackson & Tucker (2003) and Yu & Bousmina (2003) ellipsoidal models. Comparison between experiments and theories was realised using a fitting procedure that consists in incrementing the viscosity of the viscoelastic component. The agreement between both models and experimental results is reasonably fair.

S10-760

PREDICTION OF MORPHOLOGY OF POLYETHYLENE-STARCH BLENDS BY RHEOLOGICAL MODELS

LACOSTE CATHERINE [1], RONDOT SEBASTIEN [2], DELLOQUE PHILIPPE [1], DONY PHILIPPE [1], NOLOT JEAN-BAPTISTE [1], ERRE DAMIEN [1]

[1] ESIEC - LEMPE - FRANCE, [2] URCA UTAP - LASSI - FRANCE - REIMS
catherine_lacoste@tiscali.fr

The mechanical and physico-chemical properties of immiscible polymer blends strongly depend on their morphology. In order to better understand the behavior of starch in polyethylene (PE) matrix, we studied the morphology of different blends made from PE/wheat starch systems with different viscosity ratios and compositions. We compared our results to those of recent rheological concept1 that trieD to predict the morphology of other blend matrix. Following the consideration that the supermolecular structure at the limit of the cocontinuity zone is comparable to the chemical or physical incipient network obtained during the gelation and that the size and the shape of the separated domains affect directly the rheological behavior of the blends2, we have used rheological measurements, particularly in the low frequencies, to detect the existence of cocontinuous structure in PE/starch systems. The elasticity also seems to provide a sensitive way to assess the cocontinuity in polymer blends3. The study of the storage modulus G' at low frequencies versus the composition of the blend would help us to understand our morphologies. Because co-continuous morphology is a very particular case, especially if structure-property relationship has to be understood, this rheological concept has been corroborated with the evolution of mechanical properties versus viscosity ratios and composition of different blends. All of the conclusions formulated at this stage would allow to explain extraction with solvent or electric resistance measurements towards different morphologies.1. M. Castro, F. Prochazka, C. Carrot, Journal of Rheology, 49, 149 (2005).2. J.A. Galloway, C.W. Macosko, Polymer Engineering and Science, 44, 714 (2004).3. M. Castro, C. Carrot, F. Prochazka, Polymer, 45, 4095 (2004).

S10-780

Morphology and Stress Relaxation Behaviour of Co-continuous PP/EPDM Blends

MARTIN Grégory [1], BARRES Claire [2], CASSAGNAU Philippe [1], GAROIS Nicolas [3]

[1] UMR 5223 - Laboratoire des Matériaux Polymères et Biomatériaux - Villeurbanne - France, [2] UMR 5223 - Laboratoire des Matériaux Macromoléculaires - Villeurbanne - France, [3] Hutchinson Polymers - Pannes - France
gfmartin@gmail.com

Although PP/EPDM blends have been widely studied, most of their applications rely on the crosslinking of the elastomeric phase, and detailed morphological studies of uncrosslinked PP/EPDM blends are still lacking in the literature. These researches therefore aimed to bring significant and useful information regarding their morphology and relaxation behaviour, and allowed a very interesting and fruitful comprehension of the correlation between their morphology and their final mechanical properties. In particular, among all the expected morphologies, the co-continuity is virtually undescribed in the literature, whereas it is surely one of the most interesting one regarding the confinement effect of two continuous phases having a very low interfacial tension. The experimental conditions as well as the properties induced by such an atypical morphology have shown spectacular results, especially regarding the relaxation and strain recovery behaviours encountered during compression set experiments. As a matter of fact, these experiments highlighted atypical properties induced by such a morphology : an uncrosslinked co-continuous blend revealed a final strain recovery of nearly 40% (after a 25% strain applied for 10 hours at 100°C). Additionally, the study of the stabilisation of such a morphology has also brought to us interesting results. Furthermore, we have also studied the influence of hydrophilic and hydrophobic silica nanoparticles on such a specific morphology and its correlated compression set properties. Finally, the influence of the cristallinity of the continuous PP phase has also been studied in order to estimate the contribution of the crystalline fraction on the compression set experiment profiles.

S10-838

Investigations on self-reinforced domain structured polyolefin compositions processed by injection moulding

Frick Achim [1], Ruff Martin [1]

[1] *Aalen University - iPSP - Aalen - Germany*
achim.frick@htw-aalen.de

There is an impressive potential for high molecular weight polyolefins PO regarding moulded parts with superior strength. Caused by shear-induced crystallization generated during the injection moulding process the tensile strength can exceed 100 MPa. The main disadvantage processing high molecular weight material is that only parts with a short flow-length ratio can be produced. The flowability of such materials is restricted by its high melt viscosity.The idea is to develop a processable advanced high molecular weight polyolefin material composition, which enables the processing of extended parts with high strength generally.Caused by shear-induced crystallization generated between the non-miscible domains self-reinforcement will occur and strengthen the material.The aim is that the part material strength should be higher than the lowest strength of one of the outgoing material components.The present study targets on high molecular weight polyolefin compositions with improved melt flowability in order to reach a larger flow-length ratio than common HMW-PE shows.Different material compositions from polyolefin powders were prepared, processed by micro injection moulding and investigated in terms of their melt and solid-state properties.To process the powder materials by injection moulding, a unique miniaturized plasticizing unit with 12 mm diameter flat thread screw was used. The polymeric compositions and moulded specimen were investigated by rheological measurements, tensile tests, dynamic mechanical analysis (DMA) and microscopy study.The novel material composition provides for 0.5 mm thick dumbbell specimen a tensile strength of about 50 MPa where the strain at break is more than 150 %.

S10-918

Study on the Blends of Poly (lactic acid) with Thermoplastic acetylated starch blends

zhang kunyu [1], dong lisong [1]

[1] *Changchun Institute of Applied Chemistry - jilin - china*
dongls@ciac.jl.cn

Blends of poly (lactic acid) (PLA) and thermoplastic acetylated starch (ATPS) were prepared by melt mixing method. The results showed that PLA and ATPS are immiscible with the measurement of Tg by dynamic mechanical analysis (DMA) and Differrential scanning calorimetry (DSC). But the mechanical and thermal properties of the blends were improved. With increasing in ATPS content, the elongation at break was increased. The elongation at break increased from 5% of neat PLA to 183% for the blend PLA/ATPS (70/30). It was found that the cold crystallization behavior of PLA changed evidently by addition of ATPS. The cold crystallization temperature (Tcc) of PLA/ATPS blends shifted to a lower temperature and the width of exothermic peaks became narrow compared with those of neat PLA.The thermogravimetry analysis (TGA) results showed that the peak of derivative weight for ATPS moved to higher temperature with increasing PLA content in PLA/ATPS blends. It was inferred that PLA could increase the thermal stability of ATPS.

S10-942

Effect of a Small Amount of the Third Immiscible Component on the Size of Dispersed Particles in Polymer Blends

Fortelny Ivan [1], Lapcikova Monika [1], Lednicky Frantisek [1], Mikesova Jana [1]

[1] *Institute of Macromolecular Chemistry AS CR, v.v.i. - Prague - Czech Republic*
fortelny@imc.cas.cz

It is known that the addition of a small amount of component C, immiscible with A and B where A is the matrix and B dispersed phase in an immiscible blend, can lead to a strong decrease in the size of B particles. However, the effect has not been satisfactorily understood so far. Therefore, the effect of the addition of two grades of high-density polyethylene (HDPE) differing strongly in rheological properties on the size of polyamide (PA) particles in polystyrene (PS) matrix was studied. The study was complicated by remarkable non-uniformity in the phase structure of binary and ternary blends, which leads to the necessity to evaluate several thousands of particles. The effect of HDPE addition is more pronounced for blends with a higher content of PA. Differences between the effects of HDPEs with different rheological properties are detectable but not strong. In blends containing 40 % of PA, PA particles are highly elongated and branched. Therefore, specific interfacial area and continuity of PA phase are studied for these blends instead of equivalent diameter of PA particles and effect of HDPE admixture on these parameters is discussed. Acknowledgement. The authors are grateful to the Grant Agency of the Czech Republic (grant No. 106/06/0729) for financial support.

S10-1026

TERNARY POLYMER BLENDS WITH THERMALLY STABLE CHARGE STORAGE

Lovera Deliani [1], Ruckdaeschel Holger [1], Altstaedt Volker [1], Schmidt Hans-Werner [1]

[1] *University of Bayreuth - Bayreuth D-95447 - Germany*
deliani.lovera@uni-bayreuth.de

As the charge storage capability of a polymer electret strongly depends on its structure, blending is considered as a promising approach to tailor the electret performance. Blends based on poly(2,6-dimethyl-1,4-phenylene ether) (PPE) and polystyrene (PS) have previously revealed outstanding electret properties but this performance is seriously affected by high temperatures. In order to enhance the thermal charge storage behaviour, ternary blends comprising PPE/PS, of 75/25 weight ratio, and either poly(styrene-co-acrylonitrile) (SAN), poly(styrene-b-(ethylene-co-butylene)-b-styrene) (SEBS) or poly(styrene-b-isobutylene-b-styrene) (SIBS) copolymers, in concentrations ranging from 2.5 to 20 weight percent, were prepared. A systematic correlation between the electret properties, the blend composition, the final morphology as well as the compatibility between the components has been established. It was found that the charge storage capability is favoured by a non-interconnected and finely dispersed phase. Increasing amounts of SAN, SIBS or SEBS generally led to the formation of network-like morphologies and a rapid decay of the charges. The chemical nature and polarity of the third component can determine the final electret performance of the blend, as shown by the deterioration caused by the addition of highly polar SAN. Additionally, the amount of styrene in the copolymer affects its interaction with the matrix and subsequently the charge storage, since the electric charges are trapped at the interfaces. On the other hand, the presence of SIBS copolymer, especially in small quantities, led to an excellent charge storage capacity even at temperatures as high as 150 °C. In the light of these results, a detailed insight into the role of the polymer morphology on the electret performance is provided, demonstrating, once more, the potential of blending for optimizing polymer electret capabilities, especially at high temperatures.

S10-1032

A Novel In-Situ Method to Measure Interfacial Tensions in Immiscible Polymer Blends Using Focused Ion Beam and Atomic Force Microscopy.

Virgilio Nick [1], Desjardins Patrick [1], LEspérance Gilles [1], Favis Basil D. [1]

[1] *École Polytechnique de Montréal - Québec - Canada*
nick.virgilio@polymtl.ca

This paper reports on a new in-situ method to measure interfacial tensions in immiscible ternary polymer blends. This technique has a number of advantages: it allows for the measurement of interfacial tension (i.t.) directly on blends after dynamic melt-mixing preparation protocols; it allows for the measurement of i.t. in complex morphology multi-component systems; and finally it potentially provides a more accurate route towards the measurement of i.t. in interfacially modified systems. Typically, the morphology of a ternary blend can either display a complete wetting behaviour or a partial wetting behaviour, which can be predicted by calculating the well-known spreading coefficients using the interfacial tensions. In this work, it is shown that a ternary blend of high density polyethylene, polypropylene and polystyrene (HDPE/PP/PS) displays a partial wetting behaviour. Using a combination of focused ion beam sample preparation and atomic force microscopy analysis, we have measured the contact angles at the points between the components of the blend by an in-situ geometrical analysis of the morphology right after melt blending and quiescent annealing. This allows for the calculation of the ratios between the interfacial tensions of the different polymer pairs. Moreover, the results compare well with interfacial tension measurements performed with the breaking thread method.

S10-1064

Study of morphology, thermal and tensile properties in ternary blends of low density polyethylene (LDPE), high density polyethylene (HDPE) and poly(styrene-b-ethylen-co-butylen-b-styrene) (SEBS)

Medina Perilla Jorge Alberto [1], Martínez Baquero Ana Lienerh [1]

[1] *Universidad de Los Andes - Bogotá D. C. - COLOMBIA*
jmedina@uniandes.edu.co

Changes in morphology, thermal and tensile properties were evaluated in blends of low density polyethylene (LDPE), high density polyethylene (HDPE), poly(styrene-b-ethylen-co-butylen-b-styrene) (SEBS) and paraffinic oil. Nine blends were prepared under the same process conditions in a BRABENDER Plasticorder extruder, maintaining constant the relation between SEBS and paraffinic oil. Thermal properties of each blend were studied by differential scanning calorimetry (DSC). The morphology samples were prepared by selective extraction of SEBS/oil phase and the morphology was determined by SEM. In each case, tensile properties were evaluated. the results showed that tensile properties are related to morphology in the composition range studied.

S10-1181

Determination of SAN-g-PA 6 in ABS/PA 6 Alloys

Martin Weber [1], Staal Bastian [1]

[1] *BASF - D-67056 Ludwigshafen - Germany*
martin.weber@basf.com

Blending of dissimilar polymers is a versatile route to design new polymeric materials. A nice example for this are alloys based on Acrylonitrile-Butadiene-Styrene (ABS) and Polyamide 6 (PA), which posses a unique combination of properties like high toughness, good flow, and excellent chemical resistance. Hence, ABS/PA 6 alloys are widely used as materials in the automotive industry [1,2]. In these alloys the favourable properties of the different components are combined in a perfect way. In order to achieve this, Styrene-Acrylonitrile-Maleic Anhydride Terpolymers are added to ABS and PA 6 during the melt blending [3]. The compatibilizer (SAN-g-PA 6) is formed in situ during the melt blending by the reaction of the Amino-endgroups of the PA 6 with the Maleic Anhydride units in the SANMA. Thus, the real quantity of SAN-g-PA 6 formed during that process is generally unknown. In our contribution we describe attempts to determine the amount of in situ formed SAN-g-PA 6 in commercial products. In order to separate the different fractions, first an extraction step of the granulates with Hexafluoroisopropanole is done [4]. By this method the rubber fraction can be separated from all soluble material. After extraction with Acetone the fraction containing PA 6 and SAN-g-PA 6 remains. Since this fraction can not be further separated by extraction, the content of SAN-g-PA 6 can not be determined directly.In our contribution trials to determine the amount of SAN-g-PA 6 using HPLC will be presented. Furthermore, a correlation between the amount of SAN-g-PA 6 and the morphology of the alloy will be given. References[1]L.A. Utracki, Commercial Polymer Blends, Chapman and Hall, London, 1998[2]M. Weber, Macromol. Symp. 181, 189-200 (2002)[3]EP 202 214 (1986), Monsanto, Invs. R.E. lavengood, A.F. Harris, A.R. Padwa[4]M. Weber, W. Heckmann, A. Goeldel, Macromol. Symp. 233, 1-10 (2006)

S10-1229

Shear banding in biphasic polymer blends

Caserta Sergio [1], Ferrara Angelo [1], Simeone Marino [1], Guido Stefano [1]

[1] *Department of Chemical Engineering - Federico II - Naples - Italy*
scaserta@unina.it

The morphology of immiscible polymer blends, which is usually characterized by drops dispersed in a continuous phase, is strongly affected by the imposed flow conditions. In this work, we investigate the effects of the confining walls on the microstructure of polymer blends by using a rheo-optical parallel plate apparatus equipped with video microscopy and image analysis. Under some experimental conditions, we observed the formation of shear bands with alternating regions of high / low disperse phase concentration aligned along the flow direction. The shear banding process was extensively studied in terms of the main experimental variables, including gap thickness, shear rate and volume fraction. A physical interpretation of the phenomena is also proposed.

S10-1253

Parameters affecting the morphology and microstructure development of PA6/PE/organoclay nanocomposites

khoshkava vahid [1], nazockdast hossein [1]

[1] *amirkabir university of technology - tehran - iran*
nazdast@aut.ac.ir

Effect of organoclay content, feeding order and blend ratio on morphology and microstructure of PA6/PE/organoclay nanocomposite were studied. The samples were prepared by melt compounding, consisting of the melt intercalation and melt blending processes, in an internal mixer at temperature of 250ºC. The WXRD patterns of the samples showed a great extent of intercalation for neat PA6 as well as the blend samples. The TEM results revealed a partially exfoliated type microstructure in which the tactoids and/or platelets were preferentially dispersed in PA6 matrix. This was supported by the results of the melt linear viscoealstic measurements which showed a pronounced nonterminal behavior in the storage modulus (G´) along with viscosity upturn in the low frequency range as indications of a 3-D network structure formation. The SEM results showed much smaller PE particle size in the PA6/PE (80/20) nanocomposite samples compared to that in the simple blend. This could mainly be attributed to the hindrance induced reduction of the coalesance and the interfacial enhancement both caused by the tactoids and / or platelets dispersed in PA6 matrix. It was shown that, due to preferred dispersion of the organoclay in the PA6 matrix, the models introduced for prediction the phase inversion of polymer blends could not be applied for these nanocomposite samples. It was also demonstrated that, order of feeding play an important role in determining the extent of microstructure development in these samples.

S10-1287

Effect of the solvent elasticity on the stress induced demixing of a polymer blend.

Minale Mario [1]

[1] *Seconda Università di Napoli - DIAM - CIRIAM - Aversa - Italy*
mario.minale@unina2.it

Polymer blends and solutions under shear can phase separate showing regions of high polymer concentration of a few micron size aligned along the flow direction. Stress induced demixing in a polymer solution with a Newtonian solvent has been recently studied in the mainframe of a two fluid theory [Minale, submitted for publication on Macromolecules and Minale 23th PPS meeting]. To this end the Two-fluid theory has been reformulated so to be able to individuate the stress carried by each fluid constituting the solution. The predictions of stress induced demixing obtained with the new formulation have been compared with literature data and the agreement resulted to be fair. This new formulation made possible a unique interpretation of the coupling effects of stress and concentration variation in a polymer solution. Indeed within the Two fluid theory framework it was already possible to explain both the flow induced polymer migration and the enhancement of polymer concentration fluctuations. Now also a real demixing has been interpreted in the same framework. The effect of the elasticity of the solvent on stress induced demixing is here investigated. The viscoelasticity of both solvent and polymer is modelled with a constitutive equation recently proposed by Pattamaprom et al.[Macromol. Symp. (2000), 158, 1]. This constitutive equation takes into account all the relevant relaxation mechanisms (reptation, constraint release, chain stretching). It has been derived for polydisperse entangled polymers; the polymer blend is then considered as a polydisperse polymer with only two different molecular weights: the solvent one and the polymer one. The effect of solvent viscoelasticity on both the stability condition and the "quality" of the demixed solution is then quantified.

S10-103

Thermal and Mechanical Properties of In Situ Polymerized PMMA-AES blends.

Carvalho Fabiana Pires de [1], Felisberti Maria Isabel [2]

[1] UNICAMP - Sao Paulo - Brasil, [2] UNICAMP - Sao Paulo - Brasil
fcarvalho@iqm.unicamp.br

Poly(methyl methacrylate), (PMMA), has wide range of applications, which are principally concerned with high transparency and with good weathering resistance. However, it is brittle limiting these applications. The most common method for promoting the toughness of PMMA is blending with the rubber modifier. The incorporation of dispersed elastomeric particles in a rigid polymer matrix has attracted great attention because of the industrial importance of the resulting material among other types of polymer blends. Examples of successful rubber toughened plastic are high impact polystyrene (HIPS) and acrylonitrile-butadiene-styrene (ABS), these materials present low thermal resistance and low weatherability due to the high level of unsaturation of its rubber phase. Thus, research in this field has led to the production of a thermoplastic with a low level of unsaturation, poly[acrylonitrile-g-(ethylene-co-propylene-co-diene)-g-styrene] (AES). AES is very attractive due to high impact resistance and better environmental and thermal resistance than ABS and HIPS. In this work high impact poly(methyl methacrylate) (PMMA-AES) was prepared by in situ polymerization of methyl methacrylate in presence of 3, 9, 12 and 15 wt% of AES. The blends were characterized by dynamic mechanical analysis (DMA), scanning electron microscopy (SEM). The PMMA-AES blends are immiscible and present two phases, a dispersed elastomeric phase (EPDM) in a rigid matrix. The dynamic mechanical behavior of the injection molded specimens is quite different from that of the polymerized ones and it is attributed to the differences in morphology. The PMMA-AES blends were subjected to photochemical aging for 1440 h and 2880 h. Izod impact resistance of aged and non-aged samples were evaluated. The mechanical properties of the blends are influenced by the blend composition and may represent a balance of the tougheness of EPDM and the stiffeness of SAN in the PMMA matrix.

S10-157

Reactive Compatibilization and Elastomer Toughening of Poly(2,6-dimethyl-1,4-phenylene oxide)/Polyamide 6 Blends

Li Bo [1], Zhang Yong [1], Wan Chaoying [1], Ji Jiliang [2], Su Yu [2]

[1] Shanghai Jiao Tong University - Shanghai - China, [2] Kingfa company - Shanghai - China
yong_zhang@sjtu.edu.cn

Polymer blends of poly(2,6-dimethyl-1,4-phenylene oxide)/polyamide 6 (PPO/PA6) compatibilized by reactive compatibilizer PPO grafted with maleic anhydride (MA) (PPO-g-MA) and toughened by functional elastomer styrene-ethylene-butadiene-styrene block copolymer grafted with MA (SEBS-g-MA) were prepared via melt extrusion. The compatibilizing effects of PPO-g-MA on the PPO/PA6 blends were proved by scanning electronic microscope (SEM) and further confirmed by different scanning calorimetry (DSC) analysis and mechanical properties tests. The mechanical properties of PPO-g-MA/PPO/PA6/SEBS-MA blends were investigated. The impact strength of blends increased with increasing SEBS-MA content and the blends showed super-tough behavior. The fracture behavior of PPO/PA6 blends was studied using a modified essential work of fracture model (EWF), which showed that plastic deformation generated by SEBS-MA was the crucial factor for the toughening effect of SEBS-MA on the blends.

S10-177

Mechanical properties, morphology and rheology of nylon 1010/ethylene-vinyl acetate rubber / maleated ethylene-vinyl acetate ternary blends

Zhang Yong [1]

[1] *Shanghai JiaoTong University - Shanghai - China*
yong_zhang@sjtu.edu.cn

In this paper, the nylon 1010/ethylene-vinyl acetate rubber (EVM)/ maleated ethylene-vinyl acetate copolymers (EVA-g-MAH) ternary blends were prepared. The mechanical properties were investigated. Nylon/EVM (80/20) binary blend showed a slightly higher impact strength than neat nylon 1010 while all nylon/EVM/EVA-g-MAH ternary blends exhibited high impact strength (over 50 KJ/m2) with super-tough behavior. Essential Work Fracture (EWF) model was used to characterize the fracture behavior of the blends. Nylon/EVM/EVA-g-MAH (80/15/5) blend possessed the highest dissipative energy density (Ud) among all the ternary blends system. SEM images indicated the interfacial adhesion between nylon and EVM was weak but it was significantly enhanced by the introduction of EVA-g-MAH. Morphology of impact fracture surfaces indicated that the nylon/EVM (80/20) binary blend exhibited typical brittle fracture behavior, while the nylon/EVM/EVA-g-MAH ternary blends exhibited ductile fracture behavior. Rheology measurements showed the addition of EVM and EVA-g-MAH greatly increased the complex viscosity, storage modulus and loss modulus in comparison with neat nylon1010, especially at low frequencies and low shear rates. The dynamic mechanical thermal analysis (DMTA) showed the glass transition temperature of nylon slightly shifted towards low temperature after the addition of EVM.

S10-197

Dispersion and Characteristics of Carbon Nanotubes in Hyperbranched Polymer Matrix

Rana Sravendra [1], Cho Jae Whan [1], Yoo Hye Jin [1]

[1] *Konkuk University - Seoul - Korea*
jwcho@konkuk.ac.kr

The fabrication of carbon nanotube(CNT)-reinforced composites has received much attention for their many potential applications. The biggest issues in preparation of CNT-reinforced composites reside in efficient dispersion of CNTs into a polymer matrix, the assessment of the dispersion, and the alignment and control of the CNTs in the matrix. In this study, the hyperbranched polymer was employed to enhance the dispersion of CNTs into the polymer matrix and processability of CNT-reinforced polymer composites. The hyperbranched polyurethane(HBPU) based on poly(ε-caprolactone) and caster oil was synthesized, and the dispersion and properties of CNT-HBPU composites were investigated. The better dispersion of CNTs in HBPU was found compared to linear CNT-PU composites according to SEM, TEM and AFM measurements. It was also associated with the dependence of viscosity of CNT-HBPU solution on the CNT content.

S10-307

PHASE MORPHOLOGY DEVELOPMENT OF PLASTICIZED AND NON-PLASTICIZED EPDM/PP BLENDS DURING DYNAMIC VULCANIZATION

Shahbikian Shant [1], Carreau Pierre [1], Heuzey Marie-Claude [1], Ellul Maria [2],
Nadella Hari [2], Shirodkar Pradeep [3], Cheng John [3]

[1] Ecole Polytechnique de Montreal - Quebec - Canada, [2] ExxonMobil Chemical Co. - Global Specialty Polymers Technology - Ohio - USA, [3] ExxonMobil Chemical Co.-Global Specialty Polymers Technology - Texas - USA
shant.shahbikian@polymtl.ca

Thermoplastic vulcanizates (TPVs) are a special category of thermoplastic elastomers (TPEs) which are produced during an in-situ dynamic vulcanization (DV) process. Besides the intrinsic characteristics of their constituent polymeric components, their physical and mechanical properties are mainly influenced by the final phase morphology. In this work, the morphology development of two distinct EPDM/PP based immiscible polymer blends was studied during the DV process. The effects of composition of the polymeric components, amount of plasticizer and temperature on the morphology development and final structure of TPVs were studied. Based on solvent extraction and scanning electron microscopy (SEM), higher elastomer content blends result in TPVs with higher gel content during an identical period of DV process. In addition, the lower the mixing temperature, and consequently the reaction rate are, the lower the gel content and a more gradual morphology development is expected. In contrast, melt mixing at elevated temperatures increases the probability of coarse dispersed cross-linked elastomer morphology due to the rupture of the elastomeric component. Furthermore, the addition of 75% of the total amount of plasticizer in the early stage of mixing reduces the melt rheological properties of the constituent polymers. Assuming that the plasticizer is distributed into the elastomeric and thermoplastic components during the melt mixing stage, an appropriate condition (ηEPDM-oil/ηPP-oil <= 1) could be envisaged for a smooth phase morphology development during DV process.

S10-377

POLYETHYLENE BLENDS: A CORRELATION STUDY BETWEEN MORPHOLOGY AND ENVIRONMENTAL RESISTANCE

Munaro Marilda [1], Silva Guilherme Cunha [1], Linero Luiz Eduardo [2], Inone Paulo C [1],
Akcelrud Leni Campos [3]

[1] Lactec - Curitiba Parana - Brazil, [2] COPEL - Curitiba Parana - Brazil, [3] Universidade Federal do Paraná UFPR - Curitiba Parana - Brazil
marilda@lactec.org.br

HDPE is widely used in outdoor applications in which dielectric, mechanical and thermal behaviors combined with high environmental resistance are a major concern. Unfortunately, the required processing conditions of the material often result in residual stresses that in connection with environmental exposure are responsible for premature failure. In an attempt to combine good durability with more facile processing conditions for HDPE based components, blends of this polymer with LDPE and LLDPE were studied, as a function of the blend composition ratio. Measurements of crystallinity and dynamical mechanical studies were conducted which established a quantitative relationship between morphological features and composition, such as average degree of crystallinity and crystallite dimensions in the 110 and 200 planes. such as average degree of crystallinity and crystallite dimensions in the 110 and 200 planes. The optimal results in environment resistance were obtained with HDPE/LLDPE blends that were discussed here in terms of their morphology and mobility of the amorphous phase. That mobility was evaluated in terms of the tan d intensity in the region of the b transition and also that the location of a transition keeps a direct correlation with the degree of crystallinity and crystallite dimensions.

S10-394

Mechanical and optical properties of cyclo-olefin polymers (COPs) obtained by adding polysilane material (PMPS)

Tokumitsu Katsuhisa [1], Kitagawa Hiroya [1]

[1] University of Shiga Prefecture - Shiga Prefecture - Japan
ktokumit@mat.usp.ac.jp

Several kinds of optical polymershave recently attracted much attention, because they are used as a pick-up lens of a lap top computers, a camera lens of a cellular phone and so on. In order to aim further their usage expansion as an electric device, it is necessary to control the mechanical and optical properties of the polymers. In this study, the mechanical and optical properties of cyclo-olefin polymers (COPs), which is one of the most promising candidate as a optical material with high Refractive Index and low water-permeation property, were investigated when adding polysilane material (PMPS) into the COPs. From the results of ellipsometer measurement, the Refractive Index of the COPs/PMPS blend materials increased with an increase of PMPS content though, the Abbe number was changed complicatedly as depending on its chemical structure of COP. On the basis of the dynamic mechanical analyses, the glass transition temperature of COPs/PMPS decreased with an increase of PMPS content, indicating that polysilane can play the role of plasticizer for COPs.

S10-440

Using a Natural Polymer, Tannin for Polymer Blends

Bersch Paulo Inacio [1], Lim Goy Teck [1], Altstaedt Volker [1]

[1] Polymer Engineering / University of Bayreuth - Bavaria - Germany
volker.altstaedt@uni-bayreuth.de

New polymer blends with improved properties have always been in demand for applications. Under the rising pressure of our depleting oil reserve worldwide and the concern for environmental protection, the use of new blend components from low-cost renewable sources has become an interesting option for polymer research. Tannin is a natural polyphenolic compound that can be found abundantly in trees and plants [Makkar et al., 1995]. For its high content of phenolics, tannin gets oxidized easily and can be used as an effective anti-oxidizing additive for polymers. In the open literature, it is established that tannin has a good affinity with polyvinyl polypyrrolidone (PVPP) [Silanikove et al., 2001], and bind well with proteins [Naczk et al., 2001], to indicate its potential to be employed for nutritional and biomedical applications. This research aims to explore the use of tannin to blend with PVPP at various compositions, from 1 to 50 wt.-%. For the ease of study, a commercially available reagent grade of tannin (gallotannic acid) shall be adopted. The blends are prepared by a batch mixer, after which compression moulding is used to make samples for the necessary evaluation. The main goals of this work are to examine the thermal and shear rheological properties of PVPP-tannin blends, and elucidate their miscibility and blend morphology. Thermal behaviour of the blends will be characterized using thermo-gravimetric analysis and differential scanning calorimetry. Shear rheological test using dynamic time sweep will be made to show signs of material degradation and/or cross-linking, while the miscibility and morphology changes for different blends will be studied with light and electron microscopy. In all, this study can provide a more in-depth understanding of tannin blends to motivate future research in developing new binary and/or ternary blends with engineering polymers to improve overall performance.

S10-471

HYBRID POLYURETHANE-POLY(2-HYDROXYETHYL METHACRYLATE) SEMI-IPNs AND DIAMOND-CONTAINING NANOCOMPOSITES: SEGMENTAL DYNAMICS AND NANOSTRUCTURE

Bershtein Vladimir [1], Karabanova Lyudmyla [2], Sukhanova Tatiana [3], Yakushev Pavel [1], Egorova Larisa [1], Lutsyk Elena [2], Sergeeva Lyudmyla [2], Vylegzhanina Milana [3]

[1] Ioffe Physico-Technical Institute RAS - Saint-Petersburg - Russia, [2] Institute of Macromolecular Chemistry, National Academy of Sciences of Ukraine - Kyiv - Ukraine, [3] Institute of Macromolecular Compounds RAS - Saint-Petersburg - Russia
vbersht@polmater.ioffe.ru

Polyurethane-Poly(2-hydroxyethyl methacrylate) (PU-PHEMA) semi-IPNs with PHEMA content from 10 to 57 wt.% were synthesized by the sequential method. To prepare nanocomposites, 3-D nanodiamonds (NDs) with the sizes of 2 to 50-100 nm were introduced in the amounts of 0.25, 1 or 3 wt.% into a polymer system at the stage of PU synthesis. The structure of semi-IPNs and ND dispersion/spatial distribution were analyzed by AFM and IRS, whereas high-resolution laser-interferometric creep rate spectroscopy (CRS), supplemented with DSC, were used for discrete analysis of glass transitions' dynamics and estimating the elastic properties of these materials at -100 to 1800C. Chemical hybridization of both constituents occurs in these semi-IPNs resulting in anomalous behavior and the pronounced heterogeneity of glass transitions' dynamics. These hybrid networks manifest the virtually united glass transition, extending over the -60 to 1600C range, and improved thermal/mechanical stability and biocompatibility, as compared to neat PU. In the PU-PHEMA-ND nanocomposites, "double hybridization" occurs, due to reactions between residual isocyanate groups of PU network and PHEMA hydroxyls, and between isocyanates of forming matrix and active surface of ND particles. The peculiar, thoroughly cross-linked structure of nanocomposites and their structural nanoheterogeneity result in sharp changing of network dynamics in two opposite directions (constrained dynamics/nanoscale confinement effects). At elevated temperatures a sharp suppression of dynamics by 3-D NDs, with three-fold increasing of modulus of elasticity, are observed; such effects were described earlier only for nanocomposites with 2-D silicate nanolayers or 1-D carbon nanotubes. The maximal effect is observed at minimal NDs content due to improved dispersion/distribution of nanoparticles. Non-additive, synergistic effect in dynamics is observed when nanocomposites behave as “interphase controlled materials”.

S10-495

Modification of mechanical properties for PLA/PBS blends by precise morphology control

Yokohara Tadashi [1], Yamaguchi Masayuki [1]

[1] Japan Advanced Institute of Science and Technology - Ishikawa - Japan
m_yama@jaist.ac.jp

Morphology control is one of the most important factors to design polymer blends. In this study, the structure and properties are studied for biomass-based polyester blends composed of poly(lactic acid) PLA with a small amount of poly(butylene succinate) PBS. The oscillatory shear moduli for the blends demonstrate that the binary blends show phase separated structure in a molten state. Further, dynamic mechanical properties in the solid state are investigated using the samples obtained by the compression-molding. It is found that the enhancement of E’ due to the cold-crystallization of PLA is shifted to lower temperature by blending PBS. In other words, PBS accelerates the cold-crystallization of PLA. Further, crystallization behavior at a cooling process is studied by a differential scanning calorimeter and optical microscope observation, and clarifies that PBS acts as a nucleating agent for PLA. The crystallites appear at 100 oC in the blends, whereas they are not detected in the individual pure components. The enhanced crystallization is observed more prominently in the melt-drawn samples, which would be attributed to the molecular orientation of PLA as well as the enlargement of the interfacial region. As a result, PLA/PBS blend shows higher storage modulus at room temperature than the pure PLA.

S10-556

Shrinkage and phase separation during curing of epoxy/reactive rubber blends

Pionteck Jürgen [1]

[1] *Institute of Polymer Research Dresden - Saxony - Germany*
pionteck@ipfdd.de

We studied on epoxy resins based on DGEBA (diglycidyl ether of bisphenol-A), using DDS (diamino diphenyl sulfone) or AH (cis-cyclohexane-1,2-dicarboxyacid anhydride) as hardener, the effect of carboxyl terminated butadiene-co-acrylonitrile rubber (CTBN) on the epoxy curing. The epoxide curing reaction was followed by means of a GNOMIX-PVT-apparatus recording the shrinkage as measure for the degree of conversion, by DSC, and by ATR-IR spectroscopy. The curing induced phase separation was followed by optical microscopy, laser light scattering, AFM, and SEM. For comparison, a non-reactive CTBN-ester was used as modifier. The curing kinetics as well as the resulting morphology are strongly influenced by the reactivity of the rubber. In presence of catalyst the oxirane rings form to a large degree linear ether structures, while without catalyst the strong network is formed. After curing without catalyst the non-reactive rubber is strongly phase separated forming discrete spheres. The carboxylic terminal groups of the reactive rubber can react with the oxirane rings. In the DDS-containing system this reaction results only in a chain extension of the rubber molecules. An incorporation of the rubber into the epoxy phase was not detected. In presence of the catalyst the network density is reduced due to the ether formation and a partial incorporation of the rubber phase into the epoxy phase and vice versa. The blend is phase separated into mixed phases with different composition. In the anhydride-containing system the network density is reduced compared to the amino-cured epoxies. Both the CTBN and CTBN-ester are phase separated. CTBN shows good adhesion to the epoxy phase and is partially incorporated into the epoxide phase. This has a retarding effect on the curing kinetics, but the final network densities are comparable. The domains size is much lower than in the DDS-containing system and nearly transparent blends can be obtained.

S10-559

Droplet deformation and orientation in flows containing shear and elongational components

Boonen Elia [1], Van Puyvelde Peter [1], Moldenaers Paula [1]

[1] *K.U. Leuven - Leuven - Belgium*
paula.moldenaers@cit.kuleuven.be

A newly designed eccentric cylinder device has been used to study the deformation and orientation of single droplets in a controlled complex flow field. The model system, that represents industrially relevant blends, consists of poly(dimethyl siloxane) droplets in a poly(isobutylene) matrix. Both materials are Newtonian liquids at room temperature. Optical microscopy coupled with image acquisition analysis allows to monitor the behavior of droplets flowing in the annular gap between the eccentric cylinders of which only the outer one rotates. Three types of flow are considered here: simple shear, when the cylinders are concentric; eccentric flow with a certain amount of eccentricity between the cylinders and relaxation after cessation of the eccentric flow. Throughout the experiments the flow intensity was kept below the critical conditions for droplet break-up in steady 2D flows, as explored by Bentley and Leal [J. Fluid Mech., 1986, p. 241]. The experimental results for droplet deformation and orientation are compared with the predictions of the phenomenological model of Maffetone and Minale [JNNFM, 1998, p. 227]. The model predictions are obtained by using the transient form of the model and incorporating a flow type parameter that accounts for the relative amount of shear and elongational effects in the flow, as illustrated by Feigl et al. [Chem. Eng. Sci., 2003, p. 2351]. FEM-simulations are employed to extract the shear and elongation rates along a particle trajectory in the flow field. For all the sub-critical flows applied here, good agreement was found between the phenomenological model and the experimental results.

S10-597

Crystallization Behavior and Mechanical Properties of Blends of HDPE with Grond Tire Rubber Devulcanized by Microwaves

Curti Matheus Prado [1], Branciforti Marcia Cristina [2], Bretas Rosario Elida Suman [2], Scuracchio Carlos Henrique [3]

[1] Universidade de São Paulo - SP - Brazil, [2] Universidade Federal de São Carlos - SP - Brazil, [3] Universidade Federal do ABC - SP - Brazil
carlos.scuracchio@ufabc.edu.br

In this work, blends of high density polyethylene and ground tire rubber, vulcanized and devulcanized, were prepared and characterized in terms of their crystallization and mechanical properties. The ground tire rubber was treated in microwaves in several conditions, resulting in different degrees of devulcanization (crosslinks rupture), relative amount of carbon black and degradation of the polymer chains. The blends were prepared in 5 different compositions using both, the original (vulcanized) and devulcanized rubbers.The crystallization behavior was determined by DSC and SAXS. The DSC results showed that the more aggressive the devulcanization of the rubber, the higher its ability to nucleate the HDPE crystals, increasing the relative amount of the crystalline phase in the thermoplastic matrix of the blend. SAXS confirmed this increase in the crystallinity and did not showed the presence of any polymorphism, when comparing the diffraction patterns generated by the blend prepared with original and with devulcanized rubber.The mechanical properties were measure in terms of tensile tests and showed that the blends prepared with the devulcanized rubber had a higher modulus than those prepared with the original GTR. These results also confirm the higher amount of crystalline phase in the blend.

S10-600

Rheological and mechanical properties of PBT/ABS uncompabilized and compatibilized blends

Mantovani Gerson L. [1], Salomão Rafael [1], Scuracchio Carlos H. [1], Hage Jr Elias [2]

[1] Universidade Federal do ABC - Santo André, SP - Brazil, [2] Universidade Federal de São Carlos - São Carlos, SP - Brazil
gerson.mantovani@ufabc.edu.br

Two acrylonitrile-butadiene-styrene copolymers (ABS) were fully characterized and show similar overall composition with approximately 50 wt% of rubber content, however, the structural characteristics and phase morphology are very different for these materials. The effects of the different ABS copolymers on the mechanical and rheological properties and on the phase morphology of polymer blends of poly(butylene terephthalate) (PBT) with ABS copolymers compatibilized by the addition a reactive copolymer at the overall composition of 55/40/05 were studied. The copolymer of methyl methacrylate, glycidyl methacrylate and ethyl acrylate (MMA-GMA) was used as the reactive compatibilizer for the PBT/ABS system. It was observed that the graft ratio of the ABS terpolymer is very important on determining the rheological behavior, the impact strength above ductile-to-brittle temperature and the phase morphology of the neat ABS material. Also, the efficiency of the ABS terpolymer in reactive compatibilization of PBT/ABS/MMA-GMA systems depends on the characteristics of the neat ABS materials. The PBT/ABS/MMA-GMA blend based on ABS A with a lower graft ratio and higher surfactant residue shows a more homogeneous phase morphology and lower ductile-to-brittle transition temperature. Results of this work supports speculations on the effects of chemical crosslinking reactions in PBT/ABS/MMA-GMA systems due to the surfactant residue in emulsion made ABS materials.

S10-623

The effect of thermoplastic polyurethane particle size on toughening of polystyrene matrix

Javadi Azizeh [1], Barikani Mehdi [2], Nazokdast Hossein [1]

[1] Amirkabir University of Technology - Tehran - Iran, [2] Iran polymer and petrochemical institute - Tehran - Iran
ajavadi@cic.aut.ac.ir

To improve the toughness of polystyrene (PS), it was blended with thermoplastic polyurethane (TPU) using a counter rotating twin screw extruder with two screw speeds of 20 and 40 rpm. The morphology, mechanical and dynamic mechanical properties of blends were studied. The scanning electron microscopy (SEM) results illustrated a two phase morphology for all blends in which TPU was dispersed uniformly in the PS matrix. The average particle size of TPU varied from 0.4 to 2 micrometers in blends containing 10 to 50 Wt.% TPU respectively. The results of thermal mechanical analysis suggest two glass transitions for the blends and also a reduction in the glass transition temperature of PS indicating some interfacial interaction between the two phases. The results of Izod impact strength show that TPU can improve the toughness of PS up to 6 times and a Brittle Ductile Transition (BDT) is observed by using 30 Wt.% of TPU. It was found that applying low shear rate in extruder would result in better mechanical properties in blends of less than 30% TPU while for those containing more than 30% TPU using high shear rate leads to higher mechanical properties. These results can be explained in terms of blends in particular morphology and TPU particle size.Keywords: Blends- thermoplastic polyurethane- polystyrene- toughening-morphology

S10-627

New Application of Ionomer to modify Strain Hardening Intensities of Thermoplastic Polyester Elastmer

Nishioka Akihiro [1], Onodera Satoshi [1], Koda Tomonori [1], Murasawa Go [1], Miyata Ken [1]

[1] Yamagata University - Yamagata - Japan
nishioka@yz.yamagata-u.ac.jp

The effect of blended ionomers with TPEE on rheological properties were investigated. We have measured uniaxial elongational viscosities of TPEE/Etylene Ionomer blends. In case of TPEE/EMAA-54Na blend, unexpected strong strain hardening was appeared. However, this tendency was not found to other samples. To clarify causes of this unexpected results, the morphology of TPEE/Etylene Ionomer after uniaxial elongation were observed by TEM. From the result, it was considered that cause of this unexpected phenomena of TPEE/EMAA-54Na blend came from strong interaction between carboxylic acid(-COOH) of TPEE and ion aggregate of EMAA-54Na. These results may allows us that blending ionomer with TPEE is one of the new method to control intensity of strain hardening.

S10-633

The Effect of Ultrasound on EPDM/PP blends

Seong Minjun [1], Lee Jae Wook [1]

[1] Sogang Univ. - Seoul - Korea
nuj0100@hotmail.com

EPDM(ethylene-propylene diene monomer)/PP(polypropylene) blends are basically immiscible. Generally, to improve the miscibility, the curing or vulcanizing agent is used in many industries. But many chemical agents for industrial purpose have some problems that make odor. The Effect of ultrasound is known that it causes the degradation of polymer chain in polymer melt. It leads to generate highly reactive macro radicals. These radicals are so reactive that can make chemical reaction with other radicals. In polymer blends it can improve the miscibility by this reaction. If degradation of polymer chain by the ultrasound is generated in EPDM/PP blends, it can be expected that their miscibility is improved without some chemical agents.

S10-661

INFLUENCE OF MICRO- AND NANOFILLERS ON FLAMMABILITY OF POLYSTYRENE COMPOSITES

Katančić Zvonimir [1], Ptiček Siročić Anita [1], Hrnjak-Murgić Zlata [1], Jelenčić Jasenka [1]

[1] University of Zagreb - Zagreb - Croatia
zhrnjak@fkit.hr

Increasing demand for polymer materials brings new problems; the most important disadvantage of these materials concerns their low thermal resistance and fire behaviors. For this reason, flame retardants are used. Flame retardants are chemical compounds that modify pyrolysis reactions of polymers by slowing down or by inhibiting them. Most frequently used are phosphorus, aluminium, chlorine and boron-containing compounds. Today using of halogenated compounds is avoided due to degradation products which bring environmental and health concerns. In this work effect of fillers on flammability of polystyrene composites was studied. Series of polystyrene (PS) composites containing different concentrations (2 to 8 wt %) of micro- or nanofillers were prepared by extrusion. Aluminium hydroxide Al2(OH)3 was used as microfiller, and hydrophobic fumed silica Aerosil, SiO2 was used as nanofiller. It is known that flame retardants affect mechanical properties and the interface at the surface of particle inclusions plays a key role in the structure property relationship of polymer composites. For this purpose mechanical properties (tensile strength and elongation at break) of the studied samples were determined. The dispersion of filler in polystyrene matrix is important for fire retardant efficiency and was examined by scanning electronic microscopy (SEM). Flammability characterization of studied polystyrene composites was carried out by vertical burning test UL 94 (IEC 60695-11-10; ISO 1210).

S10-662

Effect of Copolymer Compatibilizer on the Impact Strength and Crystallization of a PC-PBT Alloys

Manowanna P. [1], Manuspiya H. [1],

[1] *The Petroleum and Petrochemical College - Bangkok - Thailand*
beniya_pat@hotmail.com

Polycarbonate-poly(butylene terephthalate) alloys present an excellence balance of the properties of base PC, which provides impact resistance and toughness, and that of base PBT, which provides chemical resistance. Generally, PC/PBT alloy is immiscible which cause in poor mechanical coupling between phases, resulting in low properties. Therefore, to improve the properties of alloys, the compatibilizer; in this study, ethylene-methylacrylate copolymer (EMA) was used as the added compatibilizer. All components were melt-mixed in a twin screw extruder by varying the PBT content and also compatibilizer content. Temperature, speed of screw, and moisture were controlled to avoid the degradation of the alloys and to limit the excess amount of tranesterification reaction which generally occurs in this alloys inhibiting the crystallization. The miscibility, morphology, mechanical properties were studied. Furthermore, the crystallization of alloys and the transesterification reaction before and after adding compatibilizer were also investigated.

S10-674

Grafting End-group Functionalized Poly(N-isopropylacrylamide) onto Chitosan, HTCC, and Alginate and Thermo-responsive Properties of the Grafted Copolymers

Lee Eun Ju [1], Ham Myoung Jo [1], Kim Young Ho [1]

[1] *Soongsil University - Seoul - Korea*
ssyhkim@ssu.ac.kr

Poly(N-isopropylacrylamide) (PNIPAAm), one of the most well-known thermo-responsive polymers, exhibits a lower critical solution temperature (LCST) at around 32 °C in an aqueous solution. The reversible swelling and deswelling and the thermal properties of PNIPAAm can be modulated by copolymerization with other monomers or polymers. Chitosan and alginate are non-toxic, biocompatible, and biodegradable natural polymers. And, a water soluble chitosan derivative, N-(2-hydroxy)propyl-3-trimethylammonium chitosan chloride (HTCC) could be synthesized by reacting chitosan with glycidyltrimethylammonium chloride. In this study, carboxyl-ended PNIPAAm and amine-ended PNIPAAm were synthesized via a radical polymerization of NIPAAm using mercaptoacetic acid and 2-aminoethanethiol hydrochloride as a chain transfer agent, respectively. The molecular weight of the end-group functionalized PNPAAm was controlled by changing the concentration of chain transfer agent. Chitosan-g-PNIPAAm and HTCC-g-PNIPAAm copolymers were synthesized using “graft-onto” method by reacting carboxyl-ended PNPAAm with chitosan and HTCC, respectively. Alginate-g-PNIPAAm was obtained from alginate and amine-ended PNIPAAm. The formation of the grafted copolymers was confirmed by FTIR spectroscopy, solubility test in water, and SEM-EDS. Thermo-responsive behaviors of the grafted copolymers along with the change in LCST of their aqueous solutions were also studied. Compared to the homo PNIPAAm, HTCC-g-PNIPAAm showed LCST at a slightly increased temperature. The swelling ratio of chitosan-g-PNIPAAm and alginate-g-PNIPAAm hydrogel was increased with the increase of the PNIPAAm content. Furthermore, chitosan-g-PNIPAAm hydrogel showed pH dependent behavior.

S10-678

valorisation of regenerated LDPE by blending with PS in presence of compatibilizer

Belhaneche-Bensemra Naima [1]

[1] *Ecole Nationale Polytechnique - Algiers - Algeria*
nbelhaneche@yahoo.fr

The aim of this work is to study the valorisation of two samples of LDPE coming from dirty wastes by blending with PS in presence of a compatiblizer. The first step consists to determinate the physico-chemical properties of LDPE samples (density, melt flow index, water absorption and structure by UV-visible and Fourier transform infrared spectroscopies) and mechanical properties (tensile and shore D hardness). The second step was the realisation and physical characterisation of LDPE/ PS blends (density, water absorption). In the third and last step, the effect of a compatibilizer on the properties of LDPE/PS in a weight proportion of 80/20 is considered. For that purpose, physical and mechanical characterisations were carried out. The results showed that the addition of the compatibilizer allows to improve the mechanical properties of the considered blends.

S10-704

PREPARATION AND CHARACTERIZATION OF CLAY NANOCOMPOSITES BASED ON COMPATIBILIZED POLYAMMIDE6/POLYETHYLENE BLENDS

Scaffaro Roberto [1], Mistretta Maria Chiara [1], La Mantia Francesco Paolo [1]

[1] *University of Palermo - Palermo - Italy*
mc.mistretta@dicpm.unipa.it

In this work, the effect of adding an organoclay (Cloisite 15A) to a Polyammide6/Polyethylene blend (25/75 and 75/25 wt/wt) in the presence of an ethylene-acrilyc acid copolymer (EAA), as a compatibilizing agent and a sample of a bis-oxazoline compound (PBO) as compatibilization promoter was investigated.The incorporation of the organoclay causes an increase of the viscosity of the blends, especially in the presence of the compatibilizing agents. This phenomena was considered the main responsible of the reduction of the particle dimension in all the blends.The mechanical properties of the nanocomposites are not particularly enhanced: the elastic modulus sligthy increases especially in the compatibilized blends but the elongation decrease dramatically.This apparently weitd behaviour was explained with negative interactions between the clay and the polymers: the high temperature probably causes the degradation of the organic modifier of the clay determining problems at the interface with consequent worsening of the mechanical performance. Moreover, the volatile products of the degradation may cause an expansion of the lamellar structure of the clay and, consequently, an increase of the interlayer distance.Possible degradative mechanism were hypothesized for the organoclay in three different media with a spectroscopical analysis.

S10-722

An investigation on the extended morphological properties for ternary blends of PET/EVA/PP

Abolhasani Mohamad Mahdi [1], Aref Azar Ahmad [1]

[1] *Amirkabir University of Technology - Tehran - Iran*
arefazar@aut.ac.ir

The morphology of two ternary blends was investigated. In all of the blends poly(ethyleneterephthalate)(PET), as the major phase, was blended with poly(propylene) (PP) and two grades of poly (ethylvinylacetate) (EVA) with different viscosity and interfacial interaction . Theoretical model for two grade of EVA predicted positive spreading coefficient and lower free energy for the morphology with EVA as the shell and PP as the core. In composition of 70/15/15 a core-shell type morphology for blend with high viscose EVA obtained but for blend with low viscose EVA co-continuous type morphology observed. With change in disperse phase composition of blend with low viscose EVA change in morphology investigated. Disperse phase droplet diameter and core diameter and shell thickness calculated and compared with binary blend.

S10-802

Blends of Polyvinyl chloride and thermoplastic elastomer based on poly[styrene-co-acrylonitrile)-g-(ethylene-co-propylene-co-diene)

Faria Elaine Cristina [1], Felisberti Maria Isabel [1], Carvalho Fabiana Pires [1]

[1] *UNICAMP - Campinas - Brazil*
efaria@iqm.unicamp.br

The toughness of a plastic can be enhanced substantially by blending with rubber particles. To improve the impact resistance of poly(vinyl chloride) (PVC), the possibility of combining PVC with elastomers was considered. Polyvinyl chloride (PVC), holds a unique position amongst all the polymers produced today. It is relatively inexpensive and its versatility is almost unlimited. The incorporation of dispersed elastomeric particles in a rigid polymer matrix has attracted great attention because of the industrial importance of the resulting material among other types of polymer blends. Examples of successful rubber toughened plastic are high impact polystyrene (HIPS) and acrylonitrile-butadiene-styrene (ABS), these materials present low thermal resistance and low weatherability due to the high level of unsaturation of its rubber phase. Thus, research in this field has led to the production of a thermoplastic with a low level of unsaturation, poly[acrylonitrile-g-(ethylene-co-propylene-co-diene)-g-styrene] (AES). AES is a graft copolymer based on poly[stiren-co-acrylonitrile), SAN, and poly(ethylen-co-propylene-co-diene), EPDM. It is very attractive due to high impact resistance and better environmental and thermal resistance than ABS and HIPS. This work aims to improve the impact resistance of polyvinyl chloride, PVC, using 10, 20 and 30% of AES. Those blends were prepared in a double screw extruder. Their morphology were investigated by scanning electronic microscopy; the mechanical properties were studied by tensile, flexure and impact resistance tests and the miscibility between SAN and PVC, which is responsible for the good interfacial adhesion and the good mechanical properties was observed by thermal analysis. The blends of 10, 20 and 30% of AES present an increase in elongation values in 240, 460 and 160%respectively and the blends of 20 and 30% of AES present an improvement of impact resistance of 2000 and 2700% respectively comparing to the original PVC.

S10-827

PA6/HDPE BLEND: INFLUENCE OF THE PROCESSING METHOD AND EMA-GMA COMPATIBILIZER ON THE MECHANICAL PROPERTIES AND MORPHOLOGY

Agrawal Pankaj [1], Araújo Edcleide Maria [1], Mélo Tomás Jeferson Alves [1]

[1] *Federal University of Campina Grande - Paraiba - Brazil*
tomas@dema.ufcg.edu.br

In this work the influence of the processing method and Ethylene Methyl Acrylate – Glycidyl Methacrylate (EMA-GMA) compatibilizer on the mechanical properties and morphology of PA6/HDPE blend was investigated. The results were compared to those of the blends compatibilized with polyethylene grafted with acrylic acid (PEgAA) and polyethylene grafted with maleic anhydride (PEgMA), which are two of the most used compatibilizers. The Blends were prepared by two processing methods: In the first one, the blends were dry-mixed and injection molded at 240°C. In the second one, after being dry-mixed, the blends were prepared in a counter-rotating intermeshing twin-screw extruder, at 240°C in all zones and screw speed of 50rpm. Afterwards, the obtained material was palletized, dried under vacuum at 80°C for 24h and then injection molded at 240°C. In both processing methods the composition of the blends was 80/20 (wt %) for PA6/HDPE blend and 80/10/10(wt %) for PA6/compatibilizer/HDPE blends. Tensile strength tests were carried out according to ASTM-D 638 at a cross head speed of 50mm/min. Izod impact strength tests were performed according to ASTM-D 256 in notched samples at room temperature. For the morphology studies, fracture surfaces of the samples subjected to impact strength tests were coated with gold and analyzed by Scanning Electron Microscopy (SEM). Mechanical properties (Impact strength and strain at break) results showed that the mechanical properties of PA6/HDPE blend are greatly increased when the compatibilizers are added. The SEM analysis showed that the addition of the compatibilizers to PA6/HDPE blend considerably decreases the HDPE particles average size and improves its adhesion with PA6. EMA-GMA proved to be as effective as the other two compatibilizers, regardless of the processing method.

S10-874

nonisothermal crystallization of poly(phenylene sulfide) and its blends with a thermotropic liquid crystalline polymer.

Seo Yongsok [1], Oh Kyounghwan [1], Hong Soon Man [2]

[1] *Seoul National University - Seoul - Korea,* [2] *KIST - Seoul - Korea*
ysseo@snu.ac.kr

The nonisothermal crystallization kinetics of a poly(phenylen sulfide) and blneds with a thermotropic liquid crystalline polymer were investigated by differential scanning calorimetry. A kinetic equation for nonisothermal crystallization was employed to analyze the crystallization characteristics of the terpolymer and its foam. The Avramic exponent, n, can be reasonably well determined from the nonisothermal crystallization exotherm. The polarized optical microscopy showed that pristine PPS had a well developed spherulite morphology whereas the blends consisted of much smaller spherulite morphology which is ascribed to the nucleating agent role of the thermotropic liquid crystalline polymer. The difference in crystallization behavior observed for the pristine and belnded samples is also attributed to the increase of the nucleus from the thermoropic liquid crystalline polymer.

S10-892

Polyethylene ternary blend nanocomposite

Sánchez-Solis Antonio [1], Manero Octavio [1], Bonilla-Blancas Elizabeth [1]

[1] *Universidad Nacional Autónoma de México - Distrito Federal - México*
elizabeth_bonilla@yahoo.com.mx

A nanocomposite was prepared in which the polymer matrix was a blend of polyethylenes with different densities, i.e. LDPE-HDPE-LLDPE. The disperse phase was organic modified bentonite clay. The polymer matrix was also modified with maleic anhydride (MAH) to improve compatibility with the clay. The nanocomposite preparation was a two-stage process. In the first stage, MAH was grafted to the polymer matrix by reactive extrusion using benzoyl peroxide (BPO) as a reaction initiator. In the second stage, a nanocomposite was prepared by melt blending of the polymer matrix as obtained in the first preparation stage and bentonite in a single-screw extruder. The nanocomposite showed enhanced tensile strength as compared to the pure and modified polymer matrix.

S10-928

Influence of PP Tacticity on the Miscibility of PP/LDPE Blends

Hussein Ibnelwaleed Ali [1], Suleiman M A [2], Meddad A [3]

[1] *KFUPM, Department of Chemical Engineering - Dhahran 31261 - Saudi Arabia,* [2] *KFUPM - Eastern - Saudi Arabia,*
[3] *SABIC R&T - Riyadh - Saudi Arabia*
ihussein@kfupm.edu.sa

The influence of tacticity of polypropylene (PP) on the miscibility of PP and low density polyethylene (LDPE) blends was investigated by rheological tools using ARES rheometer. In addition, the thermal and mechanical properties of the blends were studied. Commercial PP samples of different tacticities were used. Rheological measurement and data-treatment technique which include plots of η'(ϕ), η;o(ϕ) and Cole-Cole plots were used for assessment of the blends miscibility. The rheological findings were compared to free energy calculations from molecular simulation studies. AcknowledgementThe authors are grateful to KFUPM for providing the fund for this research work through project # SABIC/2005/23.

S10-936

Compatibilization and properties of poly(ethylene terephthalate)/ABS blends based on recycled materials

lashgari soheila [1], arefazar ahmad [1], moini jazani omid [1]

[1] *amirkabir university of technology - tehran - iran*
soheila.lashkari@gmail.com

In this study, blends of virgin recycled poly(ethylene terephthalate) PET with unmodified and modified ABS were prepared in the molten state. Modification of ABS was done through grafting of maleic anhydride on ABS. Mechanical and morphological properties of modified blends were compared with those of unmodified blends. The rheological behavior of selected blends was determined using a RMS device (Rheometrics Mechanical Spectrometer). Mechanical properties of PET/ABS-g-MAH blends are nearly equal or higher than those predicted by the rule of mixtures, whilst those of PET/ABS blends show negative deviation from rule of mixtures. The morphological studies indicated that the blends that showed good mechanical properties were better dispersed and had improved interphase adhesion.Keywords: blend, PET, ABS, morphology, mechanical properties

---

S10-1008

Blends of cycloolefin copolymer for medical applications

Krulis Zdenek [1], Mikesova Jana [1], Kotek Jiri [1], Horak Zdenek [1], Petrtyl Miroslav [2], Gohs Uve [3]

[1] *IMC AS CR - Czech Republic - Czech,* [2] *CTU Faculty of Civil Engineering in Prague - Czech Republic - Czech,* [3] *Institut für Polymerforschung, Dresden - Saxony - Germany*
krulis@imc.cas.cz

Blends of ethylene-norbornene copolymer with ethylene-alpha-olefin copolymers have been proven as perspective materials for construction of selected skeletal replacements. Biocompatibility testing of these copolymers shown the material is well tolerated by living tissue. However, for application in various parts of artificial prostheses (cartilages, cushioning of replacement elements etc.) a high toughness is often desired. Therefore an attempt has been made to enhance the toughness by incorporation of further component. Blending of ethylene-norbornene copolymer with selected polyethylene copolymers together with crosslinking of dispersed phase seems to be proper way to attain desirable toughness improvement. The other important mechanical characteristics are maintaining at acceptable and well-balanced level. Crosslinking of dispersed phase was carried out by incorporation of tert. butylperoxide during melt-compounding of the blends (dynamical crosslinking), or by irradiation using electron beams or gamma-rays. Standardized methods were used to determine selected mechanical properties. Morphology of the materials was investigated by scanning electron microscopy. It has been shown that crosslinking of dispersed phase leads to substantial increase in toughness. The obtained results show that crosslinking allows controlling toughness in relatively broad range.

S10-1012

Thermal Behavior and Miscibility Aspects for Polycarbonate/ Poly(ethylene terephthalate) blends

CAMPOS PATRICIA BUENO [1], LAURINDO VANESSA [2], HAGE Jr. ELIAS [3]

[1] Graduate Program in Materials Science and Engineering UFSCar - Sao Carlos SP - Brazil, [2] Undergraduate Student in Chemistry UFSCar - Sao Carlos SP - Brazil, [3] Materials Engineering Department DEMa UFSCar - Sao Carlos SP - Brazil
pbuenocampos@bol.com.br

During poly(ethylene terphthalate), PET, and polycarbonate, PC, melt blending, their molecules may react through transesterification reactions thereby leading to different molecular species. In this work, the transterification reactions between the components of the PET/PC blend and their effects on the rheological behavior and the microstructure of the blends were investigated by torque rheometry, dynamic mechanical analisys (DMTA), Differential scanning calorimetry (DSC) and polarized light optical microscopy (POM). PET/PC blends, such as 50/50 wt%, were prepared by reactive melt blending in a torque rheometer. Transesterification reactions were induced by adding tetra-n-butyl titanium (TnBT) as catalyst on concentrations of 0, 250 and 1000 ppm. Along with the melt blending, samples were taken from the mixer at different reaction times. The analisys of torque rheometry revealed that the addition of the catalyst promoted a slight increase in the values of torque observed, especially in concentrations of 1000 ppm, thereby indicating that the chemical reactions occurred between the components of the PET/PC blend. The DMTA and DSC results showed that the blends having no catalyst and with 250ppm presented two separate glass transition relaxations corresponding to a PET-rich phase and a PC-rich phase. By increasing the mixing time, it was observed that the Tgs values were slightly displaced from those of the neat homopolymers and moved towards each other. Simultaneously, the micrographs obtained by POM revealed a good dispersion of crystalline PET in amorphous phase, indicating a partial miscibility between PET and PC. On the other hand, for PET/PC blends with catalyst concentrations of 1000ppm, it was possible to observe after 5 min of blending that the PET-rich phase melting peak, has disappeared, and only a single glass transition was shown. That suggests the presence of a single homogeneous amorphous and miscible phase for the PET/PC blend.

S10-1039

Chitosan/PVA membrane: effect of sulfosuccinic acid treatment on the physical chemical properties

Witt Maria A [1], Barra Guilherme M. O. [1], Bertolino José R [1], Pires Alfredo T N [1]

[1] University Federal of Santa Catarina - Santa Catarina - Brazil
pires@qmc.ufsc.br

Chitosan (a chitin deacetylation product) is a biopolymer with good physicochemical and biochemical properties that has been used in many fields. This study investigated the effect of the presence of sulfosuccinic acid [SSA] on the physicochemical properties of chitosan/poly (vinyl alcohol) [PVA] blends, such as thermal stability, proton conductivity and mechanical resistance. The acid component is added to improve the mechanical properties with the formation of grafting of polymer chains through amino and hydroxyl groups. Different amounts of SSA were added to the chitosan/PVA blend solutions and the membranes were prepared by casting. The membranes were characterized through infrared spectra, considering the specific absorption bands, and the grafting effect evaluated through thermogravimetric curves was ca. 80%. On increasing the acid content in the mixture, the percentage of water retention decreased, suggesting a reduction in the free hydroxyl groups of the undiluted components after the grafting process. The ion exchange capacities (IEC) of membranes without and with thermal treatment (100º C for 1 h) were the same order of magnitude, with an average value of 3.45 ± 0.4 mmol.g-1 for the system with highest acid content, indicating no influence of this additional treatment. The proton conductivity of different membrane compositions was analyzed and the values were within an acceptable range for specific applications, such as in fuel cells.

S10-1059

Synthesis and characterization of Poly(MMA-b-Sty) diblock copolymers by ATRP: Using a new route to prepare compatibilizers for polymer blends.

Sordi Marli L. T. [1], Santos Amilton M. [1], Demarquette Nicole R. [2]

[1] Departamento de Engenharia Química, Escola de Engenharia de Lorena - São Paulo - Brazil, [2] Departamento de Engenharia Metalúrgica e de Materiais, Escola Politécnica - USP - São Paulo - Brazil
amsantos@dequi.eel.usp.br

In this work, poly(methylmethacrylate-b-styrene) with different block lengths were synthesized via Atom Transfer Radical Polymerization (ATRP). The goal in this work is to use a new route to the synthesis of copolymers with well defined molecular weights and architecture that may be used as compatibilizers in polymer blends. In a first step, MMA was polymerized by ATRP in solution, using toluene as solvent, CuBr/N,N,N′,N′′,N′′-pentamethyldiethylenetriamine (PMDETA) as a catalyst and ethyl 2-bromoisobutyrate (EBiB) as initiator. Poly(methylmethacrylate) (PMMA) macroinitiators with defined molecular weight, low polydispersity index (PDI), and a high end-group functionality were obtained. These PMMA macroinitiators successfully initiated block copolymerization of styrene (Sty), resulting in poly(MMA-b-Sty) diblock copolymers with low PDI and well-controlled molecular weight. Gel permeation chromatography (GPC) was used to confirm the block copolymer structure. Absolute molecular weights were obtained using a triple detector array, composed of a viscometer, a Low Angle Light Scattering (LALS) and a Right Angle Light Scattering (RALS). Copolymer composition was measured using 1H NMR spectroscopy. Copolymers with different compositions have been prepared. Keywords: diblock copolymers, ATRP, polymer blends, methylmethacrylate, styrene.

S10-1113

Intermolecular interactions and thermal behavior in blends of polyhydroxybutyrate-hydroxyvalerate (PHB-HV) and regular corn starch

Reis Kelen Cristina dos [1], Smith Andrew Charles [2], Pereira Joelma [1], Carvalho Carlos Wanderlei Piler [3]

[1] Universidade Federal de Lavras - Lavras, Minas Gerais - Brazil, [2] Institute of Food Research - Norwich - United Kingdom, [3] EMBRAPA - CTAA - Rio de Janeiro - Brazil
kelen_cr@yahoo.com.br

In recent years, there has been an increasing concern over the harmful effects of synthetic plastic materials in the environment. This ecological awareness impelled the development of new biodegradable materials, especially for single-use plastic items. Polyhydroxybutyrate-hydroxyvalerate (PHB-HV) has attracted much attention as biocompatible and biodegradable thermoplastic with potential application in agricultural, marine, and medical fields. This biopolymer is polyesters of various hydrocarboxylic acids, which are accumulated as an energy/ carbon storage or reducing power material by numerous micro-organisms under unfavorable growth conditions in the presence of excess carbon source. The thermal behavior and intermolecular interactions of blends of polyhydroxybutyrate-hydroxyvalerate (PHB-HV) with regular corn starch were studied with differential scanning calorimetry, Fourier transform infrared (FTIR) and X-Ray diffraction. The melting temperatures, melting enthalpies and crystallinities of the blends decreases as the starch content in the blends increased. FTIR measurements indicated that no intermolecular interactions existed between the two polymers as no shift in the absorption peaks of the PHB-HV or starch in the blends was observed, which suggests that PHB-HV and starch are immiscible. The blend showed low crystallinity (<4%).

S10-1116

Non-isothermal crystallization behavior of PP/ non-crystallizable polymer blends: correlation between blend compositions, crystallization and impact behavior

Jafari Seyed Hasan [1], Monemian Seyed Ali [1], Goodarzi Vahabodin [2], Gupta A. K. [3]

[1] University of Tehran - Tehran - Iran, [2] University of Tehran - Tehran - Iran, [3] Indian Institute of Tehcnology-Delhi - New-Delhi - India
shjafari@ut.ac.ir

The objective of this work is to develop and investigate various PP binary blends containing different second phase inclusion namely EPDM, ABS, PC, and PMMA as non-crystallizable polymers and their effect on crystallization and impact toughening behavior of PP. Morphology of the blends was analyzed using scanning electron microscopy (SEM). Non-isothermal crystallization behavior was investigated using differential scanning calorimetry (DSC). In PP/ EPDM blends, the rubbery component was found to act as the nucleating agent for PP, increasing the degree of crystallinity. Inversely, the nucleation rate decreased in initial stages of addition of second component for PP/ABS, PP/PC, and PP/EPDM blends. The partial compatibility of the second component as one of the essential factors controlling the nucleation rate and resulting crystallite size distribution of PP in impact toughening behavior was also considered. Finally, it was concluded that crystallite size distribution plays more significant role in impact toughening mechanisms than the degree of crystallinity in the resulted binary blends.

S10-1201

The Influence of Transreactions on the Thermal and Dynamic Mechanical Behavior of PTT/PEN Blends

Khonakdar Hossein Ali [1], Jafari S.H. [2], Golriz M. [3], Böhme Frank [4], Asadinezhad A. [2]

[1] Iran Polymer ad Petrochemical Institute - Tehran - IRAN, [2] University of Tehran - Tehran - IRAN, [3] Iran Polymer and Petrochemical Institute - Tehran - Iran, [4] IPF - Dresden - Germany
halikh@yahoo.com

An attempt was made to explore the effects of interchange reactions on the crystallization, melting, and dynamic mechanical behaviour of binary blends based on PTT/PEN prepared via melt mixing. Proton nuclear magnetic resonance (1H NMR) verified the occurrence of interchange reactions at the interface which was extended upon increasing melt processing time and temperature. The melt crystallinity of PTT was reduced where that of PEN was contributed on blending, also melt crystallization temperatures of both phases showed depression. A single composition-dependent glass transition peak was detected in second heating thermograms of the blends indicative of miscibility. Cold crystallization of PTT phase was observed to decrease while that of PEN was suppressed on blending. Also it was found that each phase crystallized individually and a melting point depression was evident suggesting compatibility. Dynamic mechanical analysis gave credence to 1H NMR and Differential scanning calorimetry results. It was observed a synergism in glassy state storage modulus of the blends suggestive of reduced specific volume of the system due to enhanced interaction and crystallinity. The secondary viscoelastic transitions of each phase in blend samples were also probed.

S10-1204

Surface and Interfacial Properties of Segmented Polyurethane - Polysulfone Blends

Ioan Silvia [1], Filimon Anca [1]

[1] Petru Poni Institute of Macromolecular Chemistry - Iasi - Romania
ioan_silvia@yahoo.com

The correlation between surface tension parameters and the chemical composition of thin films composed from poly(ester urethane) or poly(ether urethane) with different soft and hard segments, and polysulfone (PSF) or quaternized polysulfones mixtures, was investigated in order to knowledge your interfacial properties and to diversifies the applications as biomaterials and semipermeable membranes. For all investigated films of segmented polyurethanes, the polar terms contribute significantly, due to the large electron-donor interactions, to the total surface tensions. The apolar phenylene-ring from diphenylmethane 4,4'-diisocyanate reduces polarity more than that from toluene 2,4-diisocyanate - from hard segments, and, implicitly, the total surface tension parameters. Moreover, the ester and ether groups from the soft segments determine small and inconclusive differences in the surface tension parameters. On the other hand, it is known that the PSF possesses the lowest hydrophilicity. Our results indicate that the quaternized polysulfone membranes are the most hydrophilic ones from the studied samples (lowest water contact angle).It is observed that the total surface tensions of PSF are dominated by the apolar component, the total surface tensions of quaternized polysulfone are dominated by the polar component, and that the total surface tension and the polar component increase with the quaternization degree of the ammonium groups. Thus, the N, N-dimethylethanolamine side groups introduced by the quaternization process increase the polarity. In order to anticipate the interfacial properties and solid surface tension parameters of these polymer blends, the theoretical methods involving quantitative structure-property relationships were applied. The study illustrates the importance of such structural and compositional characteristics in tailoring some specific applications.

S10-1220

Dynamic Vulcanization of PVC / NBR blends

Pessan Luiz Antonio [1], Passador Fabio Roberto [2], Rodolfo Junior Antonio [3]

[1] Federal University of São Carlos - São Paulo - Brazil, [2] Federal University of São Carlos - PPG-CEM - São Paulo - Brazil, [3] Braskem S. A. - São Paulo - Brazil
pessan@ufscar.br

Dynamic vulcanization is a process of vulcanization of an elastomer during melt mixing with a thermoplastic. PVC/NBR blends can be classified as a melt processibile thermoplastic elastomer which produces parts that look, feel and perform like vulcanized rubber with the advantage of being processable as thermoplastics. In this study, a vulcanized thermoplastic was obtained by in situ dynamic curing of poly(vinyl chloride) (PVC)/nitrile rubber (NBR) blends. The crosslinking of PVC/NBR blends was accomplished using sulphur (S) / tetramethylthiuram disulphide (TMTD) and mercaptobenzthiazyl disulphide (MBTS) curative system during the reactive processing. The blends of PVC/NBR at the ratio of 90/10; 80/20 and 70/30 wt% were melt mixed using a Haake Rheomix 600 at 160°C and rotor speed of 60rpm. The curing behavior of NBR was investigated by a Monsanto Rheometer. The thermal analyses of the blends and the degree of cure of the dynamic vulcanized blends were calculated using differential scanning calorimetry (DSC) for different mixing times. The fourier transform infrared spectrum (FT-IR) was also performed for the characterization of the blends. Mechanical properties were evaluated according to specific ASTM procedures. This characterization was done by tear strength, hardness and compression set. The results show that the degree of cure increases with the mixing time and the crosslinking system used in this work was considered efficient. The best performance of tear strength was achieved with 30 phr of nitrile rubber.

S10-1222

Peculiarities of formation kinetics and the processes of phase separations of sequential semi-interpenetrating polymer networks in confined intranetwork space

Alekseeva Tatiana [1], Babkina Nataly [1]

[1] Institute of Macromolecular Chemistry - kiev - Ukraine
att7@yandex.ru

T.T. Alekseeva*, N.V.Babkina, N.V. Yarovaya,L.A. Sorochinskaya, Institute of Macromolecular Chemistry, 02160 Kiev, Kharkovskoye Shausse 48, Ukrainecorresponding author: att7@yandex.ruPeculiarities of formation kinetics of sequential IPNs based on crosslinked polyurethane (PU) with different cross-linking density and linear polystyrene (PS), polybutylmethacrylate (PBMA) have been studied. Semi-IPNs based on cross-linked PU and linear PS or PBMA were prepared by sequential method. The PU networks based on poly(oxypropylene glycol) with different MM 500, 1000, 2000 were synthesized on the I-st stage. The II-nd stage is the radical polymerization of linear component (styrene, butylmethacrylate) at equilibrium swelling PU networks in monomer. The reaction kinetic of initial PU networks, PS and PBMA formation was investigated at 60ºC using differential calorimeter. Viscoelastic and thermophysical properties of sequential semi-IPNs were investigated by the method of DMTA and DSC. It was established, that the kinetic parameters of linear polymers formation in semi-IPNs depends on Mc of PU network and chemical nature of linear polymer. The differences in reaction kinetics may be also connected to various dependence of the chain growth and termination of various monomers on the density of network. It was shown the correlation between the kinetic parameters of PS and PBMA formation in confined geometries and their MM. It was established, that for semi-IPNs based on PU-2000/PS and PU-2000/PBMA two transition temperature are observed and therefore these IPNs are two-phase polymeric systems. For semi-IPNs based on PU-1000/PS and PU-1000/PBMA closening Tg of PU- and PS- or PBMA-enriched phase relative Tg of pure components are observed. It was shown, that with decreasing of value Mc of PU network (PU-500) only single broad relaxation maximum is present, what is result of increasing compatibility of the components semi-IPNs.

S10-1249

Crystalline and amorphous extruder polyester blends and their fracture rates

Ahuja Suresh [1]

[1] Xerox - New York - USA
samka_2002@hotmail.com

Novel Blends of crystalline and amorphous polyesters were made in an extruder and the extrudates were characterized for dynamic linear visco-elastic deformation. Depending on the blend composition of crystalline and amorphous constituents, viscosity and elastic modulus of the blends decreased with the decrease in glass transition temperature of the blends. From stress strain curves, toughness of the blends was obtained which correlated to fracture rates. It appears that as the concentration of amorphous polyester is increased, interface between crystalline and amorphous domains resulted in reducing void volume and increasing Tg. Van der Waal force of adhesion which depends on the domain sizes and separation distance between the crystalline and amorphous polyester domains (modulus) increases with the amorphous polyester.

S10-1314

Preparation of polymeric matrices by using microwave energy for immobilization of radioactive waste

Caratin Reinaldo Leonel [1], Araújo Sumair Gouveia de [1], Landini Liliane [1], Lugão Ademar Benévolo [1]

[1] Instituto de Pesquisas Energéticas e Nucleares - Sao Paulo - Brazil
sgaraujo@ipen.br

The management of radioactive waste is not simple and many treatment processes have been studied to ensure that the material is handled safely. The storage of these residues depends on the composition, activity level and disposal options for the final product. It also must be done by applying chemically stable materials as immobilization matrices in order to avoid as much leaching and dispersion of compounds as possible.Nowadays, there is another problem concerning the discharge of leftovers of polymers production in landfill, where they remain for many years, before they are naturally decomposed. In this paper, the possibility of reusing vulcanized rubber was analysed, as a component of bitumen matrices for immobilization of radioactive waste. The bitumen has some advantages like plasticity with the aggregate, impermeability, stable blend and easy application. The material was used as aglomerate agent in the immobilization matrices of radioactive waste, helping the reduction of leftovers and showing resistance to leaching, radiation and aging.The bituminization process has been widely used to embed low and intermediate level radioactive waste. This method allows a stable physical, chemical and radiologycal board, in many levels of radioactive waste management.The preparation of matrices and generation of homogeneous blends of those materials were made by using microwave radiation, as heating supply. The most important characteristics of this technology are the rapid and selective heating and the environmentally clean process with low pollutant emission. It occurs when the electromagnetic waves penetrate the material, usually polar molecules, and release energy as heat.Therefore, this work aimed at showing the results of the studies that determine the ratio of bitumen/EVA rubber, suitable for incorporating radioactive waste (ion exchange resin), in a stable matrix, by applying microwave energy as heating supply.