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12th Bratislava Conference on Polymers: Modified Polyolefins for Advanced Polymeric Materials

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Conference Report

12th Bratislava Conference on Polymers: Modified Polyolefins for Advanced Polymeric Materials

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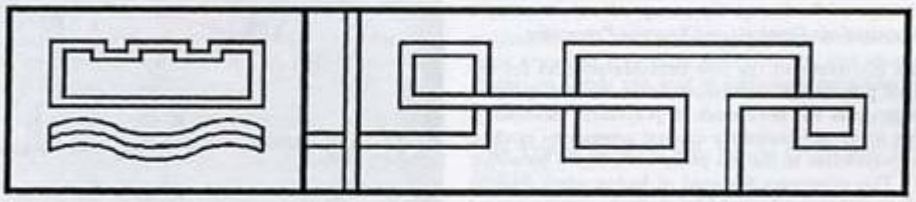
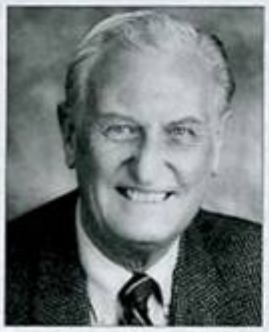


The **12th Bratislava Conference on Polymers** with the title ***Modified Polyolefins for Advanced Polymeric Materials*** was an International IUPAC/EPF Conference. It was held from August 25 to 28, 1997 in the Congress Center of Foreign Affairs in Bratislava, Slovakia. The Conference was organized by the Polymer Institute of the Slovak Academy of Sciences and was held under the auspices of the Slovak Chemical Society (SCS), the Slovak Society of Industrial Chemistry, the European Polymer Federation (EPF) and the International Union of Pure and Applied Chemistry (IUPAC). 128 Participants from 22 countries took part.

The conference was sponsored by Ciba-Geigy, Basel, Switzerland, BASF AG, Ludwigshafen, Germany, PCD Polymere Ges.m.b.H., Linz Austria, Istrochim a.s Bratislava, Slovakia, Plastica a.s., Nitra, Slovakia, Research Institute of Chemical Fibers a.s., Svit Slovakia, and the European Research Office of the U.S. Army, London, UK.

The Conference consisted of 10 Main Lectures and 22



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Congress Hall of the Ministry of Foreign Affairs

Contributed Lectures. 51 contributions were presented in Poster Form. The short abstracts of the Main Lectures are listed below:

Rolf Mülhaupt of Freiburg, Germany: *Novel Polyolefin Materials Prepared via Catalysis and Reactive Processing*

Since the discovery of the low pressure process for the preparation of polyolefins with coordination initiator systems, remarkable progress has been made in polyolefin technology. Today highly active stereoselective catalyst generations produce tailor-made polyolefins in the gas phase or in liquid monomer (propylene). This eliminates the need of hydrocarbon diluents as well as the catalyst residues and by-products, e.g. waxes and low stereoregular polymer fractions. As hydrocarbon resins, polyolefins retain oil-like energy content and can be readily utilized for normal recycling or for combustion.

Since the 1950's polyolefin catalyst and process development has been revolutionized every 15 years. Development of the magnesium halide supported catalysts has led to novel reactor blend technology, where multiphase polypropylene are produced in staged reactor systems. In recent years single metallocene catalysts have emerged as unique candidates to give excellent control in olefin homo- and copolymerizations. It is possible to control molecular weight, end groups, stereochemistry, comonomer incorporation, and morphology independently without sacrificing narrow molecular weight distribution. In addition to isotactic polypropylene, also syndiotactic, hemiisotactic and stereoblock, elastomeric polypropylenes are now available.

Old City Walls

Ivan Chodák *Rolf Mülhaupt*

P. J. Lemstra, H. Goossens, S. Rastogi and H. E. H. Meijer of Eindhoven, The Netherlands: *Processing of Intractable Polyethylenes*

Various physical methods have been developed to enhance the processing characteristics and performance of polyolefins. Here, the processing of ultra-high molecular weight polyethylene (UHMW-PE) will be specifically emphasized.

UHMW-PE is a linear PE with a molecular weight of at least 3 million and has good abrasion resistance and excellent wear characteristics. It is potentially an excellent engineering plastic but because of its extremely high melt viscosity, the polymer is considered intractable. It is supplied as a reactor powder and processed via compression-molding sintering. The actual pieces are machined from a semi-finished stock.

Various routes have been developed to improve the processing of UHMW-PE including: a.) Processing with solvents; b.) Processing with reactive solvents (monomers) and c.) Processing via the hexagonal phase, the concept of monomolecular crystals.

The Old City Hall

Otto Vogl *Eberhard Borsig*

Bela Pukanszky and Peter Szabo, of Budapest, Hungary: *Miscibility of Crystalline and Amorphous Polymers: Polyethylene/Polyisobutylene Blends*

Polymer blends are used in large quantities in all fields of applications. They have now also become important for commodity plastics. Polypropylene is modified with EPDM elastomer for impact modification, polyethylene is blended with atactic polypropylene, polyisobutylene and other elastomers. The study of the miscibility/structure/property correlation is consequently of large theoretical and practical importance.

Miscibility of the components determine the structure of the blend, which has a pronounced effect on the properties. Numerous methods are used to estimate miscibility, the most common one is the determination of the glass transition temperature. The determination of the miscibility of polyethylene blends is difficult because of the question of the correct glass transition temperature of polyethylene. For polyethylene/polyisobutylene blends, the changes of the specific heat of the polyisobutylene in combination with the interaction parameters were found to give satisfactory results and showed that the dispersion forces can lead to sufficient interaction between the two polymers.

At the Registration

Otto Vogl of Amherst, MA, U.S.A.: *Polyolefins: Syntheses and Structures*

Polyolefins currently comprise nearly 60% of the polymer production and about 75% of commodity polymers, which is about 100 million tons a year. The major olefin polymers are polyethylene, both, low and high density polyethylene and polypropylene. Styrene and polymers with diene components also play an important part.

The introduction of coordination initiators for the polymerization of olefins opened the way to prepare polyolefins in great variety. Coordination initiators allowed the tailoring of the structures and the properties of polyolefins; the type of branching could be controlled by copolymerization with selected α-olefins. For polypropylene, the degree of tacticity, the sequence of tacticity (elastomeric polypropylene), the molecular weight and the molecular weight distribution can now be modified.

Supported catalysts involving magnesium chloride and often an inert carrier allowed a significant increase of the polymerization rate leading to the 4th generation of catalysts.

The most promising development of the 1980's is the spectacular development of metallocene catalysts, catalysts that have chiral cavities for stereospecificity, and, with methylaluminoxanes might eliminate magnesium chloride with its somewhat undesirable side effects. But will these catalysts also provide the stereoregularity needed with the rate of polymer production required. This combination has not yet been demonstrated, at least not on a commercial scale.

Dietrich Braun of Darmstadt, Germany: *Chemical Modification of Polymeric Hydrocarbons*

Unsaturated polymeric hydrocarbons can undergo a number of addition reactions, like hydrogenation, halogenation, epoxidation or reactions with thiols. Saturated polymeric hydrocarbons can be substituted by a number of reagents yielding

Sung Chul Kim and Mrs. Kim on the Boat

Symbol of the Old City

some technically useful polymers, e.g. by halogenation, or chlorosulfonation. Even more important are addition reactions of saturated polymeric hydrocarbons, which will result in functionalization for further use, e.g. by introduction of polar or chemically reactive groups. Such polymers can also be applied in polyolefin blends as compatibilizers, for grafting reactions in reactive processing.

Hydrocarbons, such as polyethylene or polypropylene are incompatible with practically all other polymers and, therefore of limited use in blends. To adjust their apolar chains to more polar blend components, the polyolefins have been derivatized by peroxide initiated radical grafting with acrylic or maleic acid derivatives, which provides single units or short grafts to be attached. Side reactions due to the oxy radicals can lead to chain degradation or crosslinking.

Sung Chul Kim and Sang Young Lee of Taejon, Korea: *Gas Barrier Properties of Polyolefin/EVOH Blends*

Compatibilization of low density polyethylene/ethylene vinyl alcohol (EVOH) (70:30) blends were investigated in terms of morphology, crystallization and melting behavior, rheological and tensile properties. Morphological analysis showed that the blends exhibited finer dispersion of the EVOH phase, when low density polyethylene grafted with maleic anhydride was added. Morphology and oxygen barrier properties of these blends were studied.

Laminar dispersion of EVOH with high oxygen barrier properties was prepared in the matrix of LDPE when extruded through an annular blown film die. Various laminar morphologies were observed; the main factors determining the morphology of the blends were viscosity ratio of the blend components, processing conditions and compatibilizer level.

Properties of blends having two types of hybrid dispersed phases as laminar morphology were also investigated. These phases were prepared by either dry or melt blending of EVOH with a Nylon 6/polyethylene blend.

Manfred Rätzsch of Linz, Austria: *Challenges in Polypropylene by Chemical Modification*

Controlled radical degradation of isotactic polypropylene is a known technical process to decrease the melt viscosity of

In the Old City

C. Decker and K. Zahouily, of France: *Surface Modification of Polyolefins by Photografting of Acrylic Monomers*

C. Albano, G. Sanchez and A. Ismayel, of Venezuela: *Recycling of Polyolefins: Blends of Two Polymers*

J. Lacoste and S. Commereuc, of France: *Chemical Modifications of EVOH & EAA Copolymers at the Solid State*

M. van Duin, W. Heinen, C. H. Rosenmoeller, C. B. Wenzel, H. J. M. De Groot, J. Lugtenburg, of The Netherlands: *13C NMR Study of Grafting of 13C Labeled Maleic Anhydride onto Polyethylene, Polypropylene and EPM*

E. Passaglia, **M. Aglietto**, G. Ruggeri and F. Picchion of Italy: *Intermolecular Reaction of 2-Ethylsuccinate Containing Polyolefins with Poly-ε-caprolactam (Nylon 6)*

M. Yazdani-Pedram, K. Calderon, H. Vega and R. Quijada, of Chile: *Modification of Polypropylene with Itaconic Acid Derivatives*

J. Zicans, M. Kalnins, T. Bocoka, V. Kalkis and A. Bledzki, of Latvia: *Studies of Morphology, Rheological, Mechanical and Thermorelaxation Properties of Chemically and Radiation Modified Polyethylene/Ethylene-Propylene-Diene Copolymer Blends*

S. Jipa, **R. Setnescu**, T. Setnescu, M. Diumitru, I. Mihalcea, C. Podina and Z. Ozawa, of Romania: *Irradiation of Polyethylene in Presence of Several Additives as Studied by Chemiluminescence*

R. A. Dionisi, **M. D. Failla**, M. A.Villar, L. M. Quinzani and E. M. Vallés, of Argentina: *Modification of Propylene Ethylene Copolymers by Reactive Extrusion*

A. V. Carle, **A. C. Grillet** and N. Alberola, of France: *Blends of HMWPE, UHMWPE and TLCP: Processing and Morphology*

A. Marčincin, J. Legéň, M. Jambrich, A. Ujhelyiova, E. Zemanová, T. Marčincinová, E. Pašková, E. Borsig, A. Stupák and P. Jambrich, of the Slovak Republic: *Fiber-Forming Blends of Polypropylene and Branched Polyethylene*

The following contributions were presented in poster form:

"Morphology and Orientation of PP-Structural Foam Mouldings", "Synthesis and Characterization of New Hindered Amine Light Stabilizers", "The Formation of the Solid State Solution between Reactive Burning Retardants and Polymers", "Effect of Styrene-Butadiene-Styrene Block Copolymer on the Kinetic of Thermooxidative Degradation of High Impact Polystyrene", "Degradation Velocity of Natural Rubber Films", 'Methacrylic Acid and 2(3-Phenyl-3-methyl cyclobutyl)-2-Hydroxyethyl methacylate: Copolymerization, Characterization and Thermal Analysis Measurements", "Spectral Properties of Coumarin Derivatives Substituted in Position 3. Effect of Polymer Matrix", "Morphology of Polyethylene Foamed Crosslinked Specimens made by Hot Mold Injection Molding", "Ruthenium-Catalyzed Functionalization vs. Degradation of 1,4-Polybutadiene with Vinylsilanes", "Synthesis and Characterization of New Monomers and Polymers Containing Piperidine Groups".

"Unsaturated 2-Oxazoline Modification of Polyethylene Containing Carboxylic Groups", "Bromination of Polyolefins", "Functionalization of Polyolefins via Thermal Decomposition of Azides", "Adhesive Properties of Phosphoryl Chloride Modified Polypropylene", "Polypropylene Modified with Sulfur Dioxide", "Olefin Polymerization with Supported Metallocene Catalysts", "Structure and Properties of Ethylene Copolymers Synthesized by Metallocene Catalysts", "Morphology and Degradation Behavior of IPN Based on Polyethylene and Polymethacrylates", "Effect of Component Interaction on the Melting and Crystallization Characteristics of PE/PIB Blends", "Adhesion of Modified PE/EPDM Blends to Steel", "Radiochemical Processing of EPD/M/NR Blends", "Dyed Grafted Polypropylene Films for High-Dose Radiation Dosimetry" "Copolymerization and Characterization of End-Allenoxy oxyethylenes with N-Vinyl-2-Pyrrolidone", "Some Properties of Blends Based on High Density Polyethylene and Low Density Polyethylene Grafted with Di-2-ethylhexyl Fumarate"."

The Opera

Some participants arrived on Saturday. As a consequence, the few "early arrivals" enjoyed the evening with a walk through the old town of Bratislava ending in a dinner at the famous Franciscan Cellar which was most delightful.

Registration took place on Sunday afternoon and was followed by a Welcoming Reception at the Restaurant of the Congress Center of the Ministry of Foreign Affairs.

Monday evening a most unusual event had been planned by the organizers of the conference. It was organized by the chamber ensemble MUSA LUDENS, which invited the conference participants to a stroll into the past. The chamber ensemble has been revitalizing music and literature of central Europe dating from the time of the Great Moravian Empire, which existed in the 9th century, to the 17th century. This unique event was performed by the *Pipta family* which is devoted to the proliferation of the culture of the late middle age and included songs from the 13th to the 17th century performed in the dresses and on instruments of the corresponding time periods.

On Tuesday evening the main speakers and the key organizers were invited by the Slovak Society of Industrial Chemistry for cocktails and dinner in a special restaurant overlooking the Danube river. This complex was formerly, in communist times, the place of representation of the Central Committee.

The Organizing Committee had reserved the highlight of the conference for the banquet, which was held in a boat cruising up and down the Danube. For four hours, the boat sailed up to the Austrian Border to the confluence of the Moravia River with the

Bridge over the Danube

On the Boat

Danube. Entertainment was provided by local musicians, who provided the participants of the conference with the songs and rhythms of Slovakia. It was a unforgettable experience.

With great regret did the participants of the conference leave Bratislava and the hospitality of the Polymer Institute on Thursday, hoping to come back to Slovakia for the next Bratislava Conference on Polymers. The **13th Bratislava Conference** entitled **Macromolecular Separation and Characterization of Polymers** is scheduled for July 1999. The contact person is **Dr. D. Berek**, Polymer Institute of the Slovak Academy of Sciences, phone: +421-7-378-2306, fax: 421-7-375-923, e-mail: berek@savba.sk.