News

The Society of Plastics Engineers

ENGINEERING PROPERTIES & STRUCTURE DIVISION

April 2008

TPC Update for ANTEC 2008

— By Pierre Moulinié and Murali Rajagopalan, TPC Chairs

We're almost there! EPSDIV's program for 2008 is almost complete. The Advance Program was just released, and a few minor details still need to be ironed-out.

Our Division retained 53 papers from the submission/revision process (50 papers reported in 2007). The breakdown of Commercial/Technical contributions is 11% Commercial /89% Technical. A total of 24 reviewers helped out in late December/early January to complete the anonymous peer-review process for submitted manuscripts.

Five papers have been tagged as candidates for Best-Paper Award, and we're working with the Awards committee to ensure that judges have no scheduling conflicts to attend the upcoming presentations.

Technical Program Overview (as submitted for Preliminary Program)

- One poster and 11 podium sessions (Seven podium sessions with keynote presentation)
- So far, 18 moderators (co-moderators for the most part) have been incorporated into the schedule. Each will be contacted to relay necessary session information prior to ANTEC.
- EPSDIV currently has one joint session with Alloys and Blends — other joint sessions are envisioned.

Podium Sessions

- Advances in Bio-Derived Materials (M3/Keynote: **Dr. Richard C. Bopp**)
- Struct.-Prop. Rel. in Nanocomposites (M4/Keynote: **Prof. Musa Kamal**)
- Advances in Polyolefins (M21/ Keynote: **Dr. T. Carnahan**)
- Engrng. Prop. and Structure (M22/ Keynote: **Prof. Albert Yee**)
- Engrng. Plastics: Polycarbonate Alloys (T6/Keynote: **Dr. Bruce Hager**)
- Struct.-Prop. Relationships for Packaging Materials (T7)
- Advanced Engineering Materials (T25/Keynote: **Prof. Vipin Kumar**)
- Mat. Char./ Struct.-Prop. Rel. (T26/ Keynote: **Dr. Murali Rajagopalan**)
- Morphology and Performance (W6)
- Advances in Nanocomposites: Exfoliation and Dispersion (W20).

We look forward to seeing you all in Milwaukee !!!

VOTE

Ballot for EPSDIV Board of Directors is in this newsletter.

See pages 11-14

INSIDE THIS ISSUE

Volunteer with us — *It's Easy to Get Involved*

Brian Grady EPSDIV Chairperson

This is my last chance to speak to you via this newsletter as Chair. I would like to discuss the people that have made my job an easy one. This decision is an extremely dangerous one, since I am sure to leave out some deserving people. I want to reassure all those people that aren't mentioned that you are free to take my name in vain!

This column is important because everyone needs to know that SPE is primarily a volunteer organization, and without the volunteers SPE would cease to exist. So, in no particular order those people that have made my job an easy one include —

Mike Read: For asking me to serve as Chair, and more importantly, for always answering my e-mails to help me figure out just what I should be doing.

Pierre Moulinie: For doing a spectacular job, along with Murali Rajagoplan, with organizing the technical program at ANTEC 2008, with the added difficulty of being in Germany and hence many hours removed from US time zones.

Murali Rajagoplan: Murali deserves the credit (or the blame, depending on your point of view) for originally getting me involved with EPSDIV. Murali has shepherded our Fellow and Honored Service member nominations and, most importantly, all of the individuals who were nominated deserved the honor.

Jeff Gillmor: Jeff just gets things done, and never seems to forget anything (unlike yours truly). I know EPSDIV is in good hands next year.

Kevin Kit: For taking the lead in organizing the TOPCON in 2008. I am very excited, and truly believe that the conference will be both technically excellent and a financial success.

Brian Landes: For taking the lead in organizing the technical program for the TOPCON in 2008. The program is just spectacular; and Brian deserves all of the credit. Of course, to be fair, I am also hoping to give a contributed paper at the conference which will definitely bring the quality down!

Hoang Pham: For doing an excellent job of organizing the technical program at ANTEC 2007. The extremely large attendance at that ANTEC was due in part to the excellent programs organized by all of the Technical Program Chairs, including Hoang.

Steve Driscoll: Steve's meeting minutes are just great. I don't know how many times I have looked back at his notes to remind myself of something that was done or said.

Frank Cangelosi: Frank (and his committee) is one reason why EPSDIV is financially solvent; the number and quality of ANTEC sponsors has been spectacular.

John Trent: One of the things in this job that you realize is that all of us are very busy and have trouble writing for the newsletter; nagging a bunch of polymer scientists is not a fun thing to do and John has the unenviable job of doing just that.

Don Witenhafer: Don does a spectacular job of representing the Division at Council. Don also is the informal historian of EPSDIV, as well as sometimes the voice of reason. On a personal note, Don and I have enjoyed many a Brazilian steakhouse together, and he deserves the credit (or the blame, again depending on how you look at it!) for introducing me to Brazilian steakhouses.

The rest of the EPSDIV board members: I was honored to serve as your leader for one year, and really appreciate being given the opportunity.

For all of those of you who read this and ask "how can I get involved" and interact with such a good group of people. The best way to get started with EPSDIV is to attend the Technical Program luncheon that will happen at ANTEC on Tuesday.

Without volunteers, SPE would not exist

I, like most of us that became active in EPSDIV, started via being involved with the technical program. Suggesting topics and chairing sessions is the best way to get started. At the end of the day, it is our interest in the structure and properties of polymers that ties all of us together.

The final note of this section is to announce that I have been asked to serve on the 15 person Executive Committee of SPE. As an Executive Committee member, I do have some influence on the future direction of SPE. Please feel free to contact me, bpgrady@ou.edu, if you have any suggestions or comments. Finally, thanks again for allowing me to serve as your Chair.

—Brian Grady

Changes Planned for ANTEC

Don Witenhafer

The big news out of the January Council meeting is that ANTEC 2009 will be combined with the National Plastics Exposition (NPE) in Chicago in June. This will be a significant change for ANTEC and I am sure there will be some bumps in the road that will have to be worked out.

Part of the thinking behind this change is that we usually do not have good ANTEC attendance in NPE years and combining with NPE might help. SPI who runs NPE will handle pricing for ANTEC 2009 with a guarantee to SPE. I think this might result in a reduced registration fee for ANTEC 2009 although this has not all been worked out. I plan to book my hotel as soon as possible.

On the financial front SPE finished last year slightly less than $200,000 in the red. Heavy losses from *Plastics Engineering Magazine* are primarily responsible. We are working to resolve this issue.

International officer elections were held and Paul Anderson was elected President Elect. Ken Brainy was elected Senior Vice President. Jon Ratzlaff was elected Vice president. My congratulations to all of them.

A proposal to merge the SPE \ Foundation with SPE has been put forward. The main justification for this proposal is to reduce the expenses of the Foundation.

Lastly, on a more personal note, I would like to thank EPSDIV for nominating me for SPE Honored Service member status. I plan to accept this award at ANTEC this year

— *Don Witenhafer, Division Councilor*

Be part of EPSDIV SPE TOPCON October 2008

see page 6

Have a plastics questions?

Call our hot line

405-325-4369

Annual Financial Report: July 1, 2006 to June 30 2007

Emmett Crawford is the EPSDIV Treasurer for 2007/2008

STARTING BALANCE as of July 1, 2006 **$32668.37**

INCOME	**Actual**	**Budget**	**Variance**
Interest	1214.87	800.00	414.87
TOPCON Receipts	8233.95	000.00	8233.95
Newsletter Ads/Sponsorships	2500.00	5500.00	(3000.00)
Scholarship Contributions	1000.00	1000.00	0.00
SPE Rebate	5295.52	6000.00	(704.48)
ANTEC Sponsorships	6500.00	6500.00	0.00
Refund from Meeting (Hyatt)	44.42	0.00	44.42
Total Income	**24788.76**	**19800.00**	**4988.76**
Total Funds Available	**57457.13**	**52468.37**	**4988.76**
EXPENSES			
General Office Expenses	0.00	100.00	(100.00)
Teleconferences	387.13	1000.00	(612.87)
Board Meetings	258.80	1000.00	(741.20)
TOPCON	6114.62	10000.00	(3885.38)
Newsletter Printing/Mailing	1070.00	1750.00	(680.00)
Awards	3260.48	4500.00	(1239.52)
Scholarships/Grants	1000.00	1000.00	0.00
TPC	2835.00	4000.00	(1165.00)
Councilor Travel	1365.21	1500.00	(134.79)
BOD Travel	574.62	2000.00	(1425.38)
Student Travel Fund	500.00	500.00	0.00
Membership	0.00	300.00	(300.00)
Receptions	0.00	1000.00	(1000.00)
ANTEC Sessions	470.00	1000.00	(530.00)
Bank Fees	7.50	0.00	7.50
Total Expense	**17843.36**	**29650.00**	**(11806.64)**
ENDING Balance	**39613.77**	**22818.37**	**16795.40**

Allocation of Funds	
Checking Account	$10743.97
Investments	$28869.80
TOTAL	**$39613.77**

Treasurer's Report

— Submitted by Emmett Crawford

Account Balances at 7/1/2007

Citizens Bank	$	10,743.97
SPE Investment Plan		28,869.80
Overall Total		39,613.77

Cash Flow 7/1/2007–2/5/2008

InFlows	
02 SPE Rebate	2,456.41
03 Interest	670.40
15 ANTEC Sponsorships	500.00
Total Inflows	**3,626.81**
OutFlows	
20 BOD Meetings	961.06
23 Newsletter	535.00
27 Awards	1,000.00
30 Councilor Travel	699.38
39 Teleconferences	584.21
Total OutFlows	**3,779.65**
NET CHANGE	152.84

Account Balances at 2/5/2008

Citizens Bank	9,920.73
SPE Investment Plan	29,540.20
Overall Total	39,460.93

Best Paper ANTEC 2007 is reprinted in this newsletter.
See page 7

Plenary Speakers at ANTEC 2008

Monday, May 5: A Journey Through the 21st Century
ED BARLOW, President, Creating the Future, Inc.

Travel through the uncharted territory of the 21st century and explore the rapid and dramatic economic, technological, social, and political changes that lie ahead. What are the implications of these changes for you and your organization? How can you anticipate and prepare for continuous change? Mr. Barlow's professional experience includes executive positions in health care, business, higher education, and a Washington D.C.-based management-consulting firm. His client list represents the "Who's Who" within industry, government, and the not-for-profit sector, including: Abbott Laboratories, Hewlett-Packard, Kimberly-Clark, U.S. Navy, Lockheed Martin, and Pepsi.

Tuesday, May 6: Challenges and Opportunities in Future Feedstocks for the Plastics Industry
WILLIAM F. BANHOLZER: Corporate Vice President and Chief Technology Officer, The Dow Chemical Company

He is a member of the Dow's Management Committee, chairs the company's Innovation Committee, and leads Dow's research and development activities across the globe. Previously, Dr. Banholzer had a 22-year career with General Electric Company (GE), where he was vice president of Global Technology at GE Advanced Materials, responsible for worldwide technology and engineering.

For more on ANTEC 2008, see www.4spe.org/conf/antec08/index.php

SPE EPSDIV – TOPCON

New Approaches in Polymer Characterization: Nanocomposites, Block Copolymers and Other Nanostructured Materials

(Sponsored by EPSDIV, jointly with the SPE Philadelphia Section)

October 13-14, 2008
Holiday Inn Select
Wilmington, Delaware, USA

This two-day conference will address recent advances and remaining challenges in understanding these complex systems and will include four invited talks and two invited tutorials. Confirmed invited speakers include:

Prof. Wesley Burghardt	Northwestern University	Flow-induced Alignment in Polymer Nanocomposites
Prof. Ben Hsiao	SUNY Stony Brook	Control of Nanostructures
Prof. Richard Register	Princeton University	Crystallizable Block Copolymers
Dr. Richard Vaia	Air Force Research Laboratory	Responsivity in Polymer Nanomaterials: Structure-Property Relationships
Prof. Karen Winey	University of Pennsylvania	Combining STEM and SAXS to Probe the Morphologies in Ion-Containing Polymers
Peter Lillehei	NASA Langley Research Center	New Methods for Imaging Nanocomposites

Approximately 14 contributed 30-minute oral presentations and 25 contributed posters are being sought on topics relevant to New Approaches in Polymer Characterization of Nanocomposites, Block Copolymers and Other Nanostructured Materials. A number of posters are reserved exclusively for students, and an award will be given for Best Student Poster. Contributors should indicate preference for oral presentation, poster, or both, and **submit an abstract by March 31, 2008**. Notification of abstract acceptance will be made by April 15. Oral presenters will be expected to submit a manuscript by June 15, 2008, that adheres to the SPE WRITE NOW guide for authors and presenters and to sign the SPE copyright-release form.

Submit abstract via post or email to:
Dr. Brian Landes,
Technical Program Chair
The Dow Chemical Company
1897 Building, Midland, Michigan 48667
Tel: 989.638.7059
Email: bglandes@dow.com

Conference Chair: Kevin Kit
The University of Tennessee
Tel: 865-974-7055 Email: kkit@utk.edu

Opportunities for sponsorship and exhibiting space available.
Contact **Don Witenhafer**
Tel: 979-693-6836
Email: witenhaferd@cs.com

HOTEL INFORMATION

HOLIDAY INN SELECT
630 Naamans Road
Wilmington, DE 19703
Tel: 302-792-2700
Fax: 1 302-798-6182

Note: The hotel is 12 miles south of the Philadelphia International Airport (PHL).

Group rate: $109.00
Group code: Society of Plastics Engineers
Cut-off date: **September 21, 2008**

MELT INTERCALATION/EXFOLIATION OF POLYSTYRENE – SODIUM MONTMORILLONITE NANOCOMPOSITES USING SULFONATED POLYSTYRENE IONOMER COMPATIBILIZERS

R. A. Weiss and Nikhil Bhiwankar
Polymer Program and Dept. of Chemical Engineering
University of Connecticut,Storrs, CT 06269

Abstract

Quaternary ammonium salts of sulfonated polystyrene (SPS) were used as compatibilizers for melt-intercalation of polystyrene and pristine Na-montmorillonite. Tetra-octyl ammonium SPS and tetra-decyl ammonium SPS ionomeric compatibilizers produced significant exfoliation and a homogeneous dispersion of the polymer-clay nanocomposites. The morphology of the nanocomposites was characterized by WAXD and TEM and modulus was measured by DMTA. Image analysis was used to measure the percentage exfoliation. Exfoliation increased with increasing length of the alkyl chain of the ammonium counter-ion of the SPS ionomer.

Introduction

The most common strategies for fabricating polymer layered silicate nanocomposites (PLNs) are *in situ*-polymerization, solution intercalation and melt intercalation. Melt intercalation is the most versatile and environmentally benign method. Melt dispersion of silicate clays into polymers usually requires surface modification of the clay to improve their interactions with hydrophobic polymers. Organic modification is achieved by exchanging the interlamellar alkali/alkaline ions with long chain alkyl amines or quaternary ammonium ions. But, organic modification has its own disadvantages. It not only requires an extra step in producing polymer/clay nanocomposites, but the organic modifiers commonly used degrade at the elevated temperatures needed to process the nanocomposites and thus cause the silicate layers to regain their hydrophilicity.[1] There are few reports of ionomers being used in PLNs, and most of those studies involve organically modified clays.[2-7]. Our work involves the use of quaternary alkylammonium neutralized sulfonated polystyrene ionomers for promoting melt intercalation and exfoliation in Na-Mmt in PS using no organic modification of the clay.[8,9]

Experimental

Materials and Synthesis. Sodium montmorillonite (Na-Mmt), Cloisite Na^+, was obtained from Southern Clay Products. The cation-exchange capacity, CEC, was 0.92 meq/g and the clay was used as received without any further drying. A commercial atactic polystyrene, STYRON® 666, with M_w = 280 kDa and M_n = 106 kDa was provided by Dow Chemical Company and used as received. Sulfonated polystyrene ionomers (SPS) were prepared by sulfonating polystyrene (PS) in 1,2 dichloroethane solution using acetyl sulfate at 50°C following the procedure of Makowski et al[10]. SPS with 8.3 mol% (0.75 meq/g) sulfonation, *SPS0.75*,with three different quaternary alkyl ammonium counter-ions of varying alkyl chain length were prepared. The alkyl ammonium salts of SPS were prepared by dissolving the H-SPS0.75 in toluene/methanol solutions and neutralizing them with stoichiometric addition of the appropriate base, either *tert*-butyl ammonium hydroxide (Te-BuA), *tert*-octyl ammonium bromide (Te-OcA), and *tert*-decyl ammonium bromide (Te-DeA). The reaction was allowed to progress for 12 h, and the neutralized ionomers were isolated by steam distillation, filtered, washed several times with deionized distilled water and dried under vacuum at 80°C. The sample nomenclature used for the ionomers is *rst*-SPS*x.y*, where *rst* denotes the alkylammonium cation, TeBu-, TeOc-, or TeDe-.

Melt Processing. A DACA micro-compounder (a vertical, recirculating co-rotating twin screw extruder) produced by DACA instruments, California, USA was used for melt-processing SPS/PS/Na-Mmt blends. The extrusion temperature was 50°C above the glass transition temperature (T_g), screw speed was 190 rpm and the mixing time was fixed at 10 min. The screw speed and mixing time were optimized after several trial runs. The recirculation mode was used, so that the micro-compounder functioned as a batch mixer. After 10 min of mixing, samples were pumped out through an exit valve. Any material left after that was removed from the screws and the barrel after stopping the extruder.

Materials Characterization. 1 mm thick film samples for materials characterization were prepared by compression molding. The blend nomenclature is (*m/n*)PS/*rst*-SPS0.75/Mmt for the PS/ionomer/Na-Mmt blends, where (*m/n*) denotes the PS/SPS0.75 composition (w/w) based on the total polymer content. The composition of the silicate was fixed at 3 wt% of the total polymer mass, except for one sample that had 10 wt% silicate. The composite samples studied are summarized in Table 1.

Continued on next page

Wide angle X-ray diffraction (WAXD) was done A Bruker D8 Advance diffractometer using CuKα ($\lambda = 0.154$ nm) radiation at a voltage and current of 40 kV and 40 mA. The scattering angle (2θ) was scanned at room temperature from 3° to 12° at a scan speed of 0.1°/min. That angular range corresponded to values of the momentum transfer vector $q = 4\pi \sin\theta/\lambda$ from 2.1 to 8.5 nm^{-1}. The basal spacing of the silicate layers (d) was calculated using Bragg's law $d = 2\pi/q$.

Transmission electron microscopy (TEM) was carried out with a Philips 300 electron microscope using an operating voltage of 80 kV. Thin sections (~70 nm) were microtomed from compression molded samples at room temperature with a diamond knife using an LKB ultramicrotome. No external staining was needed. The number of platelets per particle was counted manually. TEM specimens were viewed under a magnification range of 40k -120k so as to include a large number of platelets or agglomerates, which provided good statistics of the distribution of particle sizes. For each sample, 15-20 micrographs were analyzed to determine the total number of platelets and the average number of platelets per stack. The platelets were categorized as single platelets, stacks of 2-5 platelets and stacks comprising of more than 10 platelets. The percent exfoliation was defined as the percentage of single platelets in the population.

The glass transition temperature (T_g) and change in the specific heat (ΔC_p) at the glass transition were measured with a temperature-modulated differential scanning calorimeter (MDSC™, TA2920, TA Instruments) using a heating rate of 2.5°C/min, a 60 s period heating/cooling cycle of modulation and an oscillation amplitude of ± 1°C. Dynamic mechanical properties of the composites were measured with a TA Instruments DMA model 2980 using the tensile mode and a frequency of 1 Hz. The temperature range used was -60°C to 130°C, the amplitude of vibration was 10 μm and the heating rate was 2 °C /min.

Results and Discussion

Fig. 1 shows WAXD data for PS/SPS/Na-Mmt composites as a function of alkyl chain length of the quaternary ammonium counter-ions in ammonium neutralized SPS. The original d_{001} spacing of Na-Mmt at room temperature is 1.03 nm; the difference is because of collapsing of the layers due to loss of water at high temperatures. The 150°C XRD pattern of Na-Mmt shows that the base gallery spacing for the clay was 0.96 nm. The PLNs were processed between 150 and 160°C, so it was assumed that the weakly bonded water in Na-Mmt was already lost from the clay.

The WAXD of the PS/silicate sample shows a peak at the same position as for the neat silicate that corresponds to a gallery spacing of 0.96 nm. The peak moved to lower q for the PS/ionomer/silicate nanocomposites, which indicates higher spacings for the Na-Mmt galleries. The WAXD peak for the (75/25)PS/TeBu-SPS0.75/Mmt corresponded to a d-spacing of 1.37 nm, and the $d_{(001)}$ reflection of the (90/10)PS/TeOc-SPS0.75/Mmt composite, which exhibited the maximum intercalation, shifted from 0.96 nm for Na-Mmt to 1.96 nm for the composite. Higher order reflections were not observed for any of these nanocomposites. The peak at $q \sim 5.5$ nm^{-1} in curve (e) is a result of partial intercalation in some silicate layers, while the peak at $q \sim 6.8$ nm^{-1} in curve (d) is presumably due to unintercalated layers. The peak position in curve (b) is similar to that in Na-Mmt (curve a). The large full width at half maximum of the peaks indicates large inhomogeneities of the gallery spacings, though the positions of WAXD peaks were reproducible for different batches of nanocomposites with the same composition. For comparison, the changes in the d-spacings of Na-Mmt when an equivalent amount of a low molecular weight quaternary ammonium salt, such as Te-OcA, was added in the extruder during melt mixing of PS and Na-mmt was also evaluated. In that case, the $d_{(001)}$ spacing changed from 0.96nm to 1.09nm compared with the 1.96 nm spacing observed when the TeOc-SPS ionomer was used.

A typical TEM bright field image of a (75/25)PS/TeOc-SPS0.75/Mmt nanocomposite at a relatively low magnification is shown in Fig. 2. Single clay layers, evidence for exfoliation, are present in abundance throughout the polymer matrix. However, intercalated and disordered layers also co-exist with the exfoliated silicate. The intercalated tactoids are responsible for the peak seen in the WAXD patterns while the disordered and exfoliated structures should produce scattering at lower q, which is not resolved in for the range of q measured shown in Fig. 1. Some regions in the micrograph shown in Figure 2, such as the feature marked (A) contained as many as 10-20 silicate layers stacked together. However, the majority of the clay layers were present as single layers or as stacks of 2-5 layers (see the features marked by the small arrows in Figure 2). The exfoliated layers had different lengths, with the average length between 80-140 nm. This disparity in platelet lengths may be due to a wide distribution of lateral dimensions of the starting clay [11] a variety of reasons or attrition of the platelets during shear mixing.

For the intercalated nanocomposites, the intercalated regions were more prevalent near the primary particle-polymer boundary. This was also observed in organically modified Mmt by Vaia et al. [12]. The flexibility of the layers due to their large aspect ratio and nm-thickness is clearly demonstrated by their curvature observed in fig. 2. Similar mixed morphologies of intercalated and exfoliated clay were also observed in the other PS/ionomers nanocomposites that were studied here. In contrast, when mixing only PS with the silicate, i.e., without addition of any ammonium-neutralized ionomer, only large agglomerates or 'tactoids' of clay were observed. This

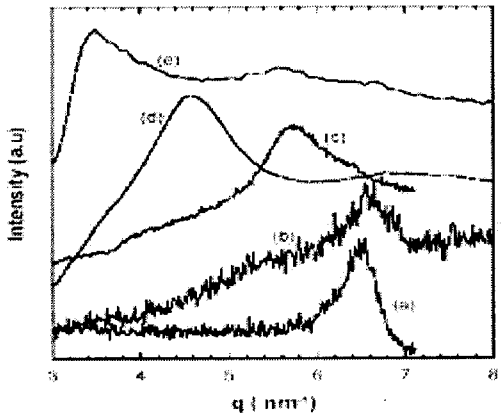
Continued on next page

further corroborated the compatibilizing effect of the ionomers at dispersing Na-mmt in these nanocomposites. The TEM micrographs shown in figure 3 compare the morphologies of the PS/SPS/clay nanocomposites. These images emphasize the excellent nano to microscale dispersion of pristine Na-Mmt without the aid of any organic modification in the compounds containing the ammonium-neutralized ionomers.

Image analysis of the particles in TEM micrographs indicated that the ionomer-compatibilized nanocomposites exhibited 65-80% exfoliation depending on the counter-ion used. The two longer alkyl chain length counter-ions, TeOc and TeDe-ammonium were significantly better at compatibilizing the clay than the TeBu-ammonium ionomer. Dynamic mechanical analysis (not shown) indicated that the modulus of the PS/clay nanocomposites was enhanced by the use of the ionomer compatibilizer; the effect above the T_g of the system was greatest.

Acknowledgment

This work was partially supported by grants from the Polymer Program of the National Science Foundation (Grant 0304803) and from NASA through the Connecticut Space Grant College Consortium. We are grateful to Prof. Robert Cohen at M.I.T. for use of his DACA extruder for this research and his graduate student, Roger Aronow, for his assistance.



WAXD of PS/SPS/Na-Mmt composites as a function of alkyl chain lengths of quaternary ammonium counter-ions in sulfonated PS ionomers. (a) Na-Mmt at 150 °C, (b) (100/0)PS/Mmt (c) (75/25) PS/TeDe-SPS 0.75/Mmt (d) (75/25) PS/TeBu-SPS 0.75/Mmt and (e) (90/10) PS/TeOc-SPS 0.75/Mmt0.75/Mmt, (d) (75/25) PS/TeBu-SPS/ 0.75/Mmt and (e) (90/10) PS/TeOc-SPS 0.75/Mmt

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Table 1: Samples

Ionomer	C_{clay} php	c_{PS} php	Sample
TeBu-SPS0.75	3	75	(75/25)PS/TeBu-SPS0.75/Mmt
TeOc-SPS0.75	3	75	(75/25)PS/TeOc-SPS0.75/Mmt
TeOc-SPS0.75	3	90	(90/10)PS/TeOc-SPS0.75/Mmt
TeOc-SPS0.75	10	75	(75/25)PS/TeOc-SPS0.75/Mmt-10
TeDe-SPS0.75	3	75	(75/25)PS/TeDe-SPS0.75/Mmt

php = parts per hundred polymer

Continued on page 10

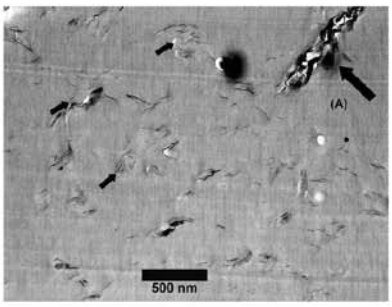

Fig.2. TEM bright field image of (75/25) PS/TeOc-SPS0.75/Mmt containing 3 wt% silicate. The micrograph shows the co-existence of exfoliated layers (small arrows) and intercalated tactoids such as (A)

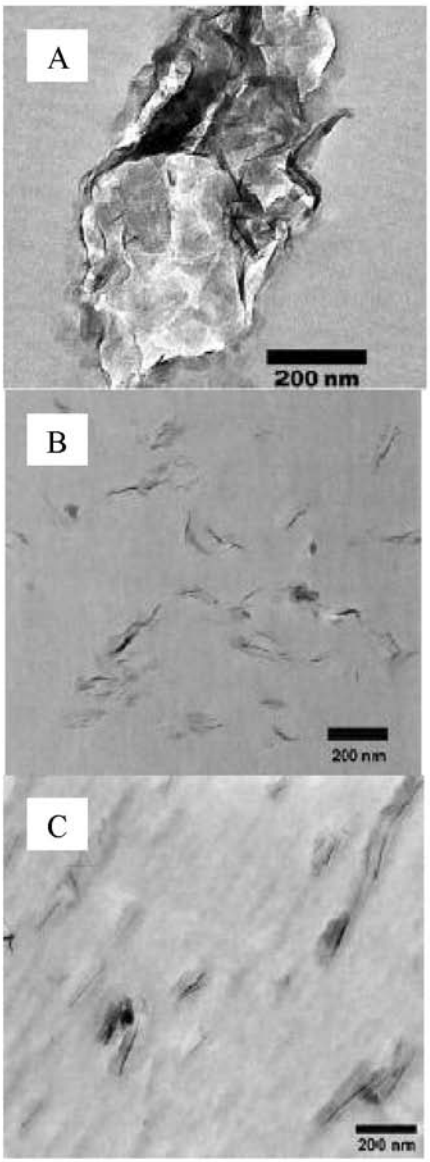

Fig. 3. Representative TEM micrographs: (A) (100/0) PS/Mmt, (B) (90/10) PS/TeOc-SPS0.75/Mmt and (C) (75/25) PS/TeDe-SPS0.75/Mmt

Engineering Properties and Structure Division

BALLOT

Board of Directors (Vote for Eight)

EMAIL your choices for Board members and Officers to Jeff Gillmor at Jeffrey Gillmor@kodak.com or PRINT the ballot and send to Jeff Gillmor, Eastman Kodak Company, 1999 Lake Avenue, Rochester, NY 14650-2104

Frank Cangelosi
Global Marketing Manager at Unimin Corporation

Frank is a Ph.D. polymer scientist with over twenty five years of experience in the chemicals, plastics, and coatings industries. He is currently a Global Marketing Manager at Unimin Corporation, where he is responsible for mineral fillers and extenders used in a variety of polymer-based systems. Prior to this, he was Director of Marketing and Technical Service for the Polymer Additives Division of Cytec Industries. Frank also worked at Union Carbide Corporation in a variety of product development, R&D management, and technology licensing positions. Along with other professional affiliations, Frank has been a leader in the Society of Plastics Engineers since 1981. He is a member and past chairman of the board of directors of EPSDIV, and is the current chairman of the board of directors of the Polymer Modifiers and Additives Division.

Rajen Patel
Development Scientist at Dow Chemical Company

Rajen Patel obtained his B.S. in Chemical Engineering from the University of Bombay in 1984. He joined university of Tennessee, Knoxville, U.S.A. in September 1985 and obtained M.S. in December 1987 and Ph.D. in May, 1991, both in Polymer Science & Engineering. He joined Polyolefins research of the Dow chemical company in June 1991 in the material science group. He has worked on various projects involving polyolefins characterization (thermal & rheological), material science and product development, including oriented shrink films, sealants, cast stretch films, blown films, elastic films and fibers. He has researched extensively in developing materials science and applications of single-site catalyzed Polyolefins. He has written a chapter on structure-properties and applications of Polyolefins produced by single-site catalyst technology in encyclopedia of chemical processing and design. He has co-authored about 15 technical journal publications. He is also a co-inventor of about 15 granted US patents. He is currently a development scientist in the plastics technical service and development group in the Dow Chemical Company.

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Raj Krishnaswamy
Senior Scientist at Metabolix, Inc

Dr. Raj Krishnaswamy is currently a senior scientist at Metabolix, Inc. where he is involved in developing commercially-viable formulations of bio-based and bio-degradable polymers for film applications and also leading many fundamental structure-property research activities. In 2007, he was nominated for and selected to participate in the National Academy of Engineers Frontiers Symposium. Prior to joining Metabolix in 2006, Raj spent nine years in the polymer science group at Chevron Phillips Chemical Company; during this tenure, he received many awards from Chevron Phillips including the "Outstanding Young Scientist" award. He is also a past recipient of the SPE Husky Education award. To date, Raj has co-authored 35 peer-reviewed journal papers and 4 book chapters; he is also a co-inventor on 16 patents (US and world-wide) and patent applications. He has also delivered invited lectures at various industries and at many universities.

Murali Rajagopalan
Director of Materials Research at Acushnet

Murali Rajagoplan is a Fellow of SPE, Director of Materials Research at Acushnet – Titleist's Golf Ball R&D as well as an Adjunct Professor at University of Massachusetts-Dartmouth in the Materials and Textiles Engineering department. He is either a solo or co-inventor of over 175 U.S. Patents in the area of golf ball materials and processing, use of vinyl alloys in HVAC, computer housing and medical devices. He has been an active Emeritus member of EPSDIV for the 6 years and was a Chair of the EPSDIV in 2001 and was with a board for the last 13 year in various capacities. He is presently a Vice Chair of New England's Rubber & Plastics Group and a member of a technical review board for the National Textile Committee for the last 3 years.

He received his M.Tech. in Fiber Science and Technology from the Indian Institute of Technology, New Delhi, India and a doctoral degree at McGill University in Montreal under the supervision of Prof. Adi Eisenberg in the area of ionomers and their blends. After graduation, he worked at B.F. Goodrich Company in the Geon Vinyl Division and made numerous contributions in the area of heat resistant vinyl alloys and blends, gamma radiation sterilizable vinyl compounds for medical devices as well and developed PVC ionomers. In 1993, he joined Acushnet Company as Materials Scientist and played a key role in the development of numerous useful materials in Titleist's golf balls for the last 15 years. He is also a co-Chair for EPSDIV's 2008 TPC with Pierre Moulinie.

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Joshua U. Otaigbe
Professor of Polymer Science & Engineering at The University of Southern Mississippi

Dr. Joshua Otaigbe joined The University of Southern Mississippi faculty in 2002 as the Professor of Polymer Science & Engineering after a successful career at Iowa State University where he was a tenured faculty member in both Depts. of Chemical Engineering and Materials Science & Enginering, and Leader of Polymers and Composite Research Group. Before joining Iowa State, he worked as a Project Leader for Corning Incorporated in New York. Earlier, he held academic positions at the University of Alberta, Canada, and University of Benin in Nigeria. Dr. Otaigbe earned his B.S. degree in industrial chemistry in Nigeria and the Ph.D. degree in polymer science and engineering from the University of Manchester (UMIST), England. In 2002, Dr. Otaigbe was elected a Fellow of the United Kingdom Institute of Materials, Minerals & Mining for contributions of international significance to the polymer and composite materials field. This is the highest honor bestowed upon professional members of this international science and engineering institute. He is also a Fellow of the Society of Plastics Engineers (SPE) and a member of the SPE-EPSDIV Board of Directors. Dr. Otaigbe is the recipient of numerous national and international awards including the prestigious U.S. National Science Foundation CAREER Award and a visiting professorship at the Swiss Federal Institute of technology (ETH-Zurich) in Zurich, Switzerland. Dr. Otaigbe's research is in the areas of polymer engineering, rheology and materials science. His research blends chemical engineering with materials structure and property principles to understand and improve processes for advanced materials.

Pierre Moulinié
Scientist with Bayer MaterialScience

Pierre obtained a Ph.D. in Chemistry from Carleton University in Ottawa, Canada in 1996 studying Synthesis and Characterization of Poly(ether ketone)s. After graduating, he joined the Industrial Materials Institute in Boucherville (part of the National Research Council of Canada) and worked with a research team investigating thermoplastic foams - and focused on gas solubility and diffusivity. In 1999 he moved to Pittsburgh to join Bayer Corp. and turned his focus to Polycarbonate Blends. Since 2004, Pierre has been on International Assignment with Bayer MaterialScience AG in Dormagen (Germany), leading Makroblend (PC/Polyester) Innovation.

Brian Landes
Technical Leader at Dow Chemical Company

Brian is currently a Technical Leader in the Surface/Microscopy/X-ray Group, Core R&D at the Dow Chemical Company. His scientific interests include effects of processing on polymer morphology and structure, development of in-situ, time resolved, and high throughput characterization technology, and the development of image visualization, reduction, and analysis software. He earned his Ph.D. in Polymer Science from the Pennsylvania State University. He is active in K-12 science education programs, and is active within the academic, industrial, and national laboratory communities. He has been a member of SPE for 28 years and is a past chair of EPSDIV

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Greg. McKenna
Professor in Chemical Engineering at Texas Tech University

Subsequent to receiving his Bachelors degree in Engineering Mechanics at the U.S. Air Force Academy, Gregory B. McKenna went on to MIT where, in 1971, he earned a Masters Degree in the area of composite materials before entering on active duty as a test and evaluation engineer at Hill Air Force Base in Ogden, Utah. While in Utah, he completed his higher education by earning a Ph.D. in Materials Science and Engineering at the University of Utah in 1976. Dr. McKenna then moved to the then National Bureau of Standards as a National Research Council Postdoc and then accepted a permanent position as a staff scientist at NBS (now NIST). Since then, Dr. McKenna has earned a reputation as a pioneering researcher in four major areas of polymer and plastics science and technology: Physical Aging and Structural Recovery of Polymer Glasses, Solid Mechanics and Nonlinear Viscoelasticity of Polymers, Thermodynamics and Mechanics of Elastomers and Gels, Molecular Rheology. He was the head of the Structure and Mechanics Group in the Polymers Division at NIST from August, 1992 until July, 1999 when he became Professor in Chemical Engineering at Texas Tech University.

Write-in Candidate for Board of Directors Position

EPSDIV Board of Directors 2007-2008

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