Society of Plastics Engineers • Upper Midwest Section

June 2015 • *Volume 41*

THE SPECIALIST

Minitech 2015

Tuesday, June 23, 2015 – 12:30 pm registration. 1:00 pm – 4:30 pm presentation

Hennepin Technical College, Room J110 – Auditorium • 9000 Brooklyn Blvd, Brooklyn Park, MN 55445

More information and to register: www.uppermidwestspe.org

The Importance of Molecular Weight in Injection Molding

Tim Morefield – Polysource • Sean Mertes – Polymer Technology Services

Seminar #1 – 1:00 pm to 2:30 pm – Tim Morefield

Molecular weight is a key fundamental material property which corresponds directly with both the physical and rheological properties of all thermoplastic resins. The practical ramification of this key material characteristic is often not well understood. The objective of this presentation is to provide an introduction to the basic concept of molecular weight in polymers, an overview of analytical techniques used for characterization of molecular weight in polymers along with practical examples of how this fundamental material property manifests itself as well as practical ramifications relative to quality assurance considerations.

Seminar #2 – 3:00 pm to 4:30 pm – Sean Mertes

While Molecular Weight provides superior physical properties, processing higher MW can sometimes be difficult to injection mold. Don't confuse Molecular Weight with Melt Flow, while they both tend to tell us the same story, MFI can be deceiving. We will discuss how using scientific, systematic or decoupled molding techniques can hopefully simplify the process. We will discuss how molecular weight of the resin typically directly correlates with pressure loss in the part, warpage, and stress. We will also discuss how utilizing a Universal Set Up sheet can simplify the ability to move from press to press.

Tim Morefield - Polysource

I began my career in the plastics industry over 30 years ago at GE Plastics after receiving my BS in Mechanical Engineering. While there I held various positions in the Lexan product group, advanced design & engineering group and the polymer processing development group. While at GE I obtained my Masters in Polymer Science. Subsequently I was the technical manager for a compounding operation for several years after which I worked as an independent consultant in the plastics industry for approximately 18 years before joining PolySource in my current position in 2012.

Sean Mertes – Polymer Technology Services

I began my professional career 26 years ago working at custom Injection Molding company as a Plastics Project Engineer after receiving my Master of Science in Mechanical Engineering. In 1996, I accepted a Technical Service Representative position with General Polymers (later known as Ashland and currently Nexeo) to cover the Minnesota territory. After fourteen years in that role, I advanced to the position of Application Development Engineering for corporate accounts throughout the U.S. I joined Polymer Technology and Services, LLS (PTS) as Sales Manager for the Midwest Region in 2013.

COST:

Advanced Registration (Thru June 19, 2015, 5:00 pm): Member: $25 • Non-Member: $50 • Students: No Charge

Late Registration: June 20 - June 23 / At the door: Member: $35 • Non-Member: $60 • Students: $5

REGISTRATION – (Credit Cards now accepted)

Register NOW at www.uppermidwestspe.org • For reservations or questions, email Sean Mertes (sdmertes@ptsllc.com).

If you don't have access to the internet then call Sean Mertes at 612-750-5159 - EMAIL IS PREFERRED

President's Remarks *Shilpa Manjure*

I have heard somewhere that time flies when you are having fun but in our case time has literally zoomed by! Yes, it has already been a year since this board took office and I wanted to take a moment to THANK each and every one who helped put together the successful events in this past year. We organized a Golf Outing, a plant tour, a MegaTech, a MiniTech, an Annual Social & Awards dinner and gave scholarships to about 7 deserving students!!! It has been an exciting year putting together these educational and fun events for networking for all the SPE members in the Upper Midwest section. Hoping you continue to take advantage of these opportunities in your backyard as we plan to bring more to you this year.

Our spring MiniTech on Injection Molding, held in April had a record breaking attendance of close to 100 people. Needless to say, we are glad to have Sean Mertes as our Program Chair again who worked with Beaumont & AIM to put this seminar together. As always, students attended the seminar for free. Thanks to UW Stout and Hennepin Tech for their active participation in this SPE event.

I am also pleased to report that our Scholarship Program is now gaining popularity. Thanks to Thomas MacNamara and Paul Rothweiler for initiating and bringing structure to this program. We are indeed thrilled to encourage and recognize deserving students. The chapter gave out scholarships to a total of 4 students for the Tony Norris and Jerome Formo Award. So students spread the word about the Scholarships and if there is not a student chapter at your school please contact Tom or me directly!

Another program that is now an annual feature is the Annual Meeting and Social. This event got its current shape due to the efforts of LuVerne Erickson. Verne retired from the board and his position as Chief Scientist at Clariant Corp., last year. The board recognized his services with an Upper Midwest West Service Award. Details about Verne's career and work have been included as a part of this newsletter later. Congratulations and Thank you Verne!

Finally, we have two events organized this summer – a Minitech on June 23, continuing on our Injection Molding education series and a Golf Outing on August 4 at Oak Marsh. Please see details attached and mark your calendars for the two days.

Looking forward to meeting you at our next events this summer!

Sincerely, Shilpa Manjure

WELCOME TO OUR NEW MEMBERS - Hamid Quraishi, Membership Chair

We are pleased to welcome our newest members of the Upper Midwest Section. As of March 30, 2015, our section has 363 active members! Tell your friends and co-workers about the SPE Upper Midwest Section to help us grow and check out our website, www.uppermidwestspe.org, and the national website, www.4spe.org, to know all that SPE and this section has to offer

New Member	Affiliation
Mark Menuzuber	MTS Systems

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SERVICE AWARD

Verne Erickson honored for his service to SPE's Upper Midwest Section

LuVerne Erickson was honored with a Service Award by the Upper Midwest SPE on April 21, 2015, at the Spring MiniTech Seminar, for his many years of distinguished service to the Society. The ceremony was held at the Hennepin Technical College, Brooklyn Park.

Mr. Erickson, a resident of Golden Valley for forty-two years, worked in the plastic industry for forty-four years. He received his BS degree in Chemistry from Wartburg College in Waverly, Iowa and started his career in the plastics industry in 1971 as a color matcher for Charles B. Edwards Co. Verne held various positions including laboratory manager, plant manager, maintenance manager, and chief chemical engineer in charge of new product development and product safety. Charles B. Edwards Company was purchased by Cookson PLC of London and became Spectrum Colors, which was purchased by Sandoz and became Reed Spectrum which was divested by Sandoz to become Clariant Corporation, a Swiss company. He retired from Clariant in December 2014. Verne was a member of SPE and the Upper Midwest Section since 1981. He served for six years with the local division as Awards Chair and in this role revived an event that is now a regular feature of SPE's Upper Midwest Section.

We are thankful to Mr. Erickson for his dedicated service to the Upper Midwest SPE Board and plastics community! Congratulations!

ANNUAL GOLF TOURNAMENT

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The Upper Midwest section of SPE is proud to announce our annual golf tournament for 2015.

TUESDAY AUGUST 4, 2015
Tee Time: 10 a.m.
Registration begins at 9:30 a.m.

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If you plan to come please e-mail me so I can make sure we have enough space reserved.

THERMOPLASTIC POLYURETHANE/POLYLACTIC ACID TISSUE SCAFFOLD FABRICATED BY TWIN SCREW EXTRUSION AND MICROCELLULAR INJECTION MOLDING

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Abstract

Polylactic acid (PLA) and thermoplastic polyurethane (TPU) are two kinds of biocompatible and biodegradable polymers that can be used in biomedical applications. They possess rigid and flexible mechanical properties. The TPU/PLA blend tissue scaffolds at different ratios were fabricated via twin screw extrusion and micro-cellular injection molding techniques (a. k. a. MuCell) for the first time. Multiple test methods were used in this study. Fourier transform infrared spectroscopy (FTIR) verified the presence of the two components in the blends. Differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA) confirmed the immiscibility between TPU and PLA. Scanning electron microscopy (SEM) images affirmed that the PLA was dispersed as spheres or islands inside the TPU matrix, and that the phase morphology further influenced the surface rough-ness of cells. The blends exhibited a wide range of mechanical properties that cover most human tissue requirements. It was found from DMA and viscosity tests that 25% PLA significantly reinforces the blends at low temperatures or deformation frequencies.

Introduction

Tissue engineering is aimed at the regeneration of malfunctioning tissues and the fabrication of whole or partial artificial organs for transplantation. It is attracting more and more attention since it was reported by Langer [1]. Tissue scaffolds, which act as extracellular matrices (ECM) for cell adhesion, proliferation, migration, and differentiation, play a pivotal role in tissue engineering [2]. The main challenge for tissue engineered scaffolds is to design and fabricate three-dimensional (3D), highly porous scaffolds capable of fulfilling the requirements of the target tissue. The optimal pore size for tissue regenera-tion depends on the type of tissue [3]. Mechanical pro-perties and surface chemistry are two other important factors which influence the usefulness of the scaffold, as well as cell adhesion and migration. Various materials provide different mechanical properties. Likewise, rough scaffold surfaces can help to improve cell adhesion [4, 5].

PLA is the most popular biocompatible and bio-degradable polymer been used. It has also been widely used in the tissue scaffold field, for applications including bone regeneration [6], blood vessel scaffolds [7], and cartilage scaffolds [8]. However, PLA alone can usually only be used in hard tissue scaffolds due to its naturally high strength and brittleness. Recently, bioresorbable polyurethane (PU) scaffolds have been attracting considerable attention as a potential material for tissue engineering [9]. TPU is a class of PU that has been widely employed in medical applications due to its flexibility and excellent abrasion and tear resistances [10]. Therefore, a scaffold combining PLA and TPU at various ratios would yield multiple desirable properties suitable for different tissue applications.

Several methods have been used to fabricate tissue scaffolds including solvent casting/particle leaching, thermally induced phase separation, electrospinning, rapid prototyping, batch foaming, and microcellular injection molding [11-15]. Among them, microcellular injection molding is a relatively new method which is organic-solvent free and has the potential to mass produce tissue scaffolds. In this paper, PLA and TPU were melt blended at a variety of ratios and fabricated into scaffolds via microcellular injection molding technology. The miscibility, mechanical properties, foaming behavior, and rheology properties were investigated.

Experimental

Materials

TPU (Elastollan 1185A, BASF Ltd., USA) is an elastomer that provides flexibility to the blends. PLA (3001D, NatureWorks LLC., USA) was selected to improve the rigidity of the blends. Both TPU and PLA have close melt processing windows, thus allowing them to be combined effectively.

Scaffold Fabrication

TPU and PLA pellets were dried with a circulating air flow at 100 ºC for 3 hours prior to compounding. Materials with various formulations—including PLA, PLA75%, PLA50%, PLA25%, and TPU—were compounded with a twin-screw extruder (Leistritz ZSE 18 HPe) at 190 ºC (the die temperature) at 110 rad/s screw speed, followed by water cooling and granulation.

The pre-blended granules were dried for 3 hours at 100ºC to remove any moisture before being used for microcellular injection molding. The injection molding machine used was an Arburg Allrounder 320S equipped with a supercritical carbon dioxide supply system (MuCell® Trexel, Inc.). The processing parameters for the microcellular injection molding procedure are listed in Table 1. Both solid and foamed samples were produced.

Table 1. Microcellular processing parameters.

Parameters	Value
Cooling Time	60s
Clamp Tonnage	200 kN
Mold Temperature	23 °C
CO2 Content	4% wt.
Injection Volume	70% vol
Injection Speed	20 cm3/s
Plasticizing temperature	190 °C
Back Pressure	6 MPa

Characterization

Fourier Transform Infrared Spectroscopy (FTIR)

FTIR measurements were carried out using a Bruker Tensor 27. The samples were analyzed in the absorbance mode in the range of 600 to 4000 cm-1. Functionalities corresponding to each of the absorption bands were analyzed.

Differential Scanning Calorimetry (DSC)

Thermal property measurements were performed on a DSC Q20 (TA Instruments). Samples were encapsulated in standard aluminum pans and covered with standard lids. Samples were heated to 220ºC at a heating rate of 10 ºC/min and held isothermal for 5 minutes to erase prior thermal history. They were then cooled to –80 at 5 ºC/min and heated to 220 ºC again at 10 ºC/min. All tests were carried out under the protection of nitrogen.

Dynamic Mechanical Analysis (DMA)

Thermal dynamic properties of the samples were examined in single cantilever mode by a TA Instruments DMAQ 800. The samples were trimmed to 35.6 mm long by 12.8 mm wide by 3.2 mm thick. The tests were performed at a temperature range of –60 ºC to 150 ºC at a heating rate of 5 ºC/min with a frequency of 1 Hz. Liquid nitrogen was used to generate the low temperature and control the temperature during heating.

SCIENCE CORNER continued on page 6

Scanning Electron Microscopy (SEM)

The phase morphology of the solid samples and, as well as the microstructure of the foamed samples, were evaluated using a Nikon JEOL Neoscope SEM with an accelerating voltage of 10 kV. All specimens were frozen in liquid nitrogen and broken by two clamps in cross section at the bending center. SEM observations were performed after sputtering the samples with a thin film of gold for 40 seconds.

Mechanical Properties

Tensile tests of dog bone bars were performed on a universal mechanical testing machine (Instron 5967), according to the standard test method for tensile properties of plastics (ASTM D638). The tests were performed at ambient temperature (23 ºC) with a cross-head speed of 50 mm/min. A 600% tensile strain was set as the termination requirement of the test due to limitations associated with the instrument. The same instrument was outfitted with compressive damps for compression tests of rectangular samples following the standard test method (ASTM D695). All samples were compressed to 50% strain at a speed of 5 mm/min. Statistical results were the average value of five samples.

Viscosity

The complex viscosity of the pure material and the blends was measured via a rheometer (AR 2000ex). A 25 mm, 0 ETC steel plate geometry was used and all of the tests were performed at 190 ºC, with an increase in angular frequency from 0.1 to 200 rad/s.

Results and Discussion

Miscibility of TPU and PLA

FTIR Results

FTIR was used to identify the molecular construction of the blends. As shown in Figure 1, the peak at 3332 cm-1, which indicates the N–H group in urethane (–NHCOO–), and the peaks at 2935 and 2850 cm-1, which belong to the asymmetric and symmetric vibration of the –CH2 group, are characteristic peaks of TPU. Furthermore, the intensity of the peaks in the blends was enhanced by increasing TPU content. The –C=O group peak at 1748 cm-1 only existed in PLA, and the peak intensity decreased with increasing TPU content. FTIR results confirmed that PLA and TPU were compound success-fully and no chemical reaction happened during melt blending since no new chemical bonds were identified.

DSC and DMA Analysis

DSC results shown in Figure 2 indicate that TPU and PLA were immiscible, which can be diagnosed from the completely separate glass transition slopes. As the TPU content increased, the glass transition temperature (Tg) of the two components remained constant, while the slope of the TPU became steeper and the slope belonging to the PLA became shallower. It was also found from Figure 2 (a) that the PLA cold crystallization peak moved to a lower temperature and the peak intensity became sharper in the PLA75% and PLA50% samples. This phenomenon can be attributed to the addition of TPU, which acted as a crystallization. nucleation agent by providing nucleation sites for the PLA. Among the three blends, both the cold crystallization peak and the melting peak became smaller with increasing TPU content. Figure 2 (b) shows the cooling period, where it can be seen that PLA stimulates TPU crystallization as well, with the peak becoming stronger as PLA content increases

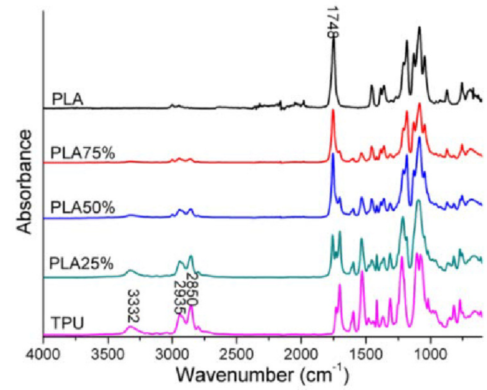

Figure 1. FTIR results of PLA, PLA75%, PLA50%, PLA25%, and TPU samples.

The tan delta results from the DMA test (cf. Figure 3) clearly showed the immiscibility of TPU and PLA as well. The depletion peak for the TPU content was below zero and became weaker as the PLA content increased. Simi-larly, the PLA depletion peak, which occurred around 76 , became smaller when the TPU content increased. All of the blends had two peaks at the same temperatures as pure TPU and PLA, which confirm that the PLA and TPU used in this study were completely immiscible. The sharp peak for PLA indicated rapid storage energy loss.

Phase Morphology

SEM was used to further study the phase morphology of PLA/TPU blends. The pure PLA and TPU fractured surface morphology results are shown in Figure 4 (a) and (b), respectively, for comparison. Figures 4 (c) through (e) show the phase morphology of the three blends. A large portion of the PLA spheres were uniformly inlaid in the TPU matrix. No continuous PLA phase was observed in the PLA75% sample even though the spheres were large and almost connected to each other. The PLA50% sample had both PLA and TPU continuous phases, as well as some PLA spheres, as shown in Figure 4 (d). The PLA domain, however, formed islands inside of the TPU matrix (circled in the image), and the spheres were much fewer than in the PLA75% sample. As shown in Figure 4 (e), the PLA25% sample had tinny PLA spheres that were much smaller and less frequent than in the PLA75% sample and were also uniformly dispersed in the TPU matrix. In brief, clear phase separation was observed

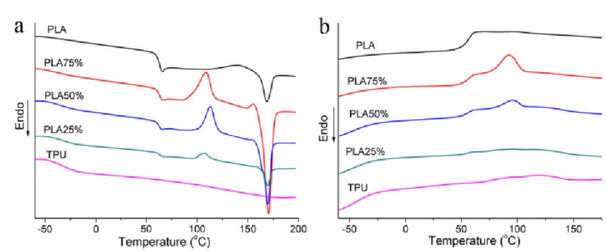

Figure 2. DSC results of pure materials and blends: (a) second heating and (b) cooling.

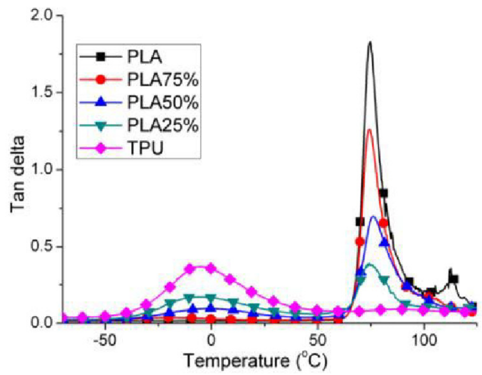

Figure 3. DMA tan delta results of pure materials and blends.

in all three blends, which further proves that PLA was com-pletely immiscible with TPU.

Scaffold Morphology

The microstructures of the foamed samples are shown in Figure 5. The morphology of the pure PLA and TPU were significantly different and the cell structure varied between blends. It was found that the cell size of the TPU was much larger than that of PLA, and more cells had small holes which could connect with other cells. The PLA75% sample (Figure 5 (c1)) had a similar structure to the pure PLA sample. Furthermore, the morphology of the PLA25% sample (Figure 5 (e1)) was close to that of pure TPU. The PLA50% sample (Figure 5 (d1)) had large hollow regions and small cells. It is likely that the differ-ence in scaffold microstructure could be attributed to the various phase morphologies.

The PLA and TPU phase interfaces provide hetero-geneous nucleation points during foaming. The enlarged images show the phase morphology of the cell surface and cell wall. Pure materials (Figures (a2) and (b2)) have relatively smooth cell surfaces, while the surfaces of the other three blends were rough. Large PLA spheres were found inlaid in the PLA75% scaffold, forming a rough cell wall and small hollow regions on the cell surfaces. The two-phase morphology in the PLA50% scaffold in both cell wall and

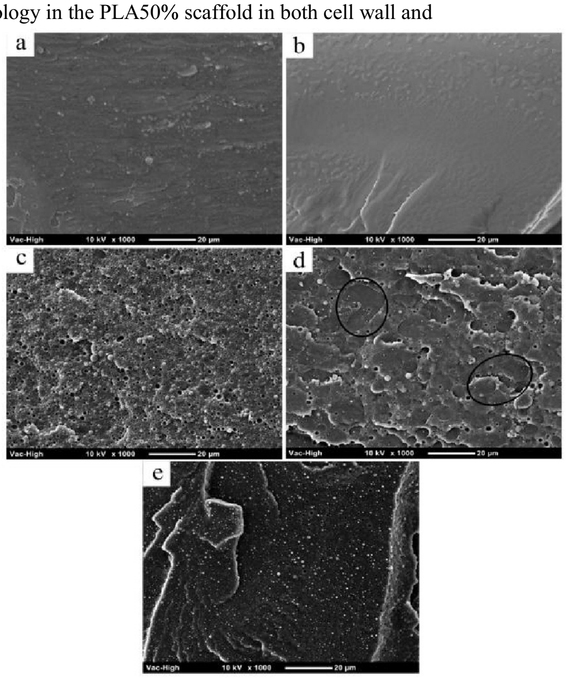

Figure 4. SEM phase morphology of (a) PLA, (b) TPU, (c) PLA75%, (d) PLA50%, and (e) PLA25% solid samples.

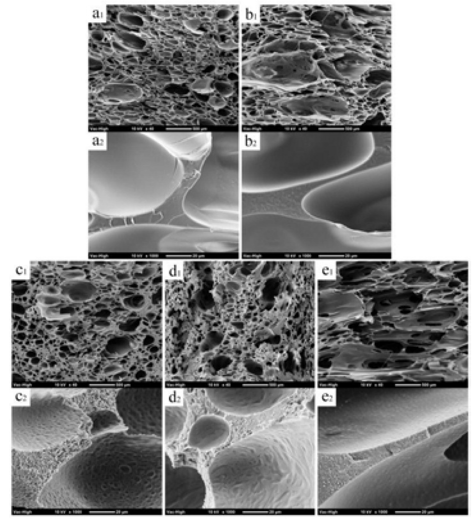

Figure 5. SEM images of microcellular injection molded samples: (a) PLA, (b) TPU, (c) PLA75%, (d) PLA50%, and (e) PLA 25%. Subscript 2 images are enlarged images of subscript 1 images.

cell surface can be clearly seen in Figure 5 (d2). The PLA25% scaffold (Figure 5 (e2)) had tiny PLA spheres dispersed uniformly on the cell surface, thus forming a rough surface.

Mechanical and Rheological Properties

Tensile and Compressive Tests

The tensile and compressive test results of solid and foamed samples are shown in Figure 6, and the tensile modulus and compressive modulus statistical results are shown as Figure 7. Pure PLA had a high tensile modulus as well as compressive modulus, but an extremely low elongation-at-break due to its brittle nature. The tensile and compressive yield stresses decreased with the addition of TPU. In addition, the stresses decreased with decreas-ing PLA content. Solid TPU samples and blend samples did not break during the tensile test, even when the strain reached 600% as shown in Figure 6 (a). Figure 6 (b) shows that the strain-at-break increased with increasing TPU content for foamed samples, and that the samples lost yield behavior when the PLA content decreased to 25%. The compression test showed similar results as the tensile test. In Figures 6 (c) and (d), it can be seen that the compressive modulus decreased with increasing TPU content. Furthermore, the compressive stress for foamed samples was significantly lower than that of solid samples. According to the histogram data in Figure 7, both the tensile modulus and the compressive modulus decreased as the TPU content increased. The tensile modulus of foamed samples was lower than that of solid samples and ranged from 7 to 1007 MPa, which is large enough to cover several tissue applications. The compres-sive modulus for foams, which ranged from 11 to 200 MPa, would also fulfill some human tissue requirements.

Dynamic Mechanical Test

PLA had a higher storage modulus than TPU accord-ing to thermal dynamic tests, as shown in Figure 8. The storage modulus curves of the blends were located between PLA and TPU for both solid and foamed samples as expected. Interestingly, both solid and foamed PLA25% samples had a relatively high storage modulus at low temperatures. This might have been due to the rein-forcement behavior of the rigid PLA spheres uniformly dispersed in the TPU matrix corresponding to the phase morphology images. As the temperature increased, the storage modulus

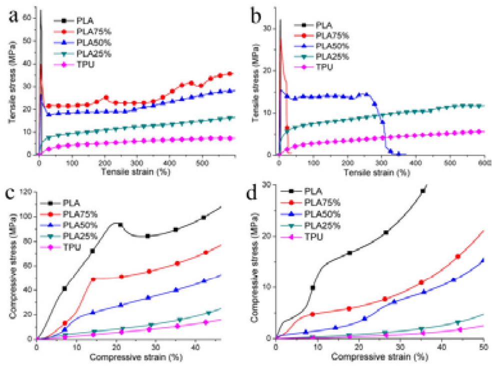

Figure 6. Mechanical property tests: (a) tensile test of solid samples, (b) tensile test of foamed samples, (c) compressive test of solid samples, and (d) compressive test of foamed samples.

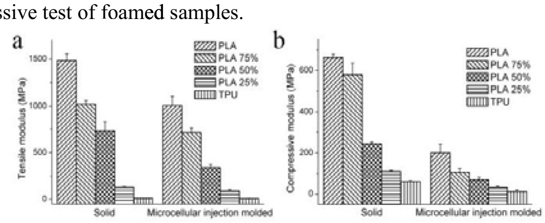

Figure 7. Statistical histogram of (a) tensile modulus and (b) compressive modulus for both solid and foamed samples.

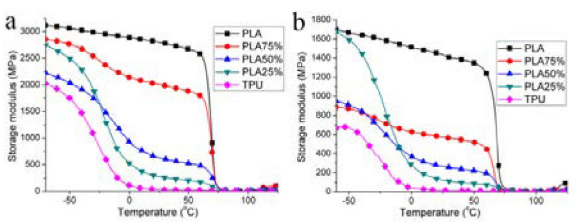

Figure 8. DMA storage modulus of pure materials and blends: (a) solid samples and (b) foamed samples.

dropped rapidly such that no improve-ments were observed in the tensile or compression tests at room temperature.

Rheology Test

As shown in Figure 10, the complex viscosity in-creased along with the amount of TPU because pure TPU had a higher viscosity than pure PLA. The reinforcement behavior of PLA25% was also observed in the rheology tests at low angular frequencies. Together with the storage modulus results, it is possible that the tiny PLA spheres in the PLA25% were acting as rigid fillers, which significantly reinforced the blends at low temperatures or deformation frequencies. The PLA50% samples had a continuous PLA phase, while the PLA75% samples had large PLA spheres and a small TPU domain, thus no reinforcement behavior was observed in them.

Conclusions

TPU and PLA were melt blended in different ratios with a twin-screw extruder and microcellular injection molded to produce tissue scaffolds. The properties of pure materials and blends were investigated via multiple test methods. It was found that the PLA and TPU used in this study were completely immiscible and that the PLA dispersed as

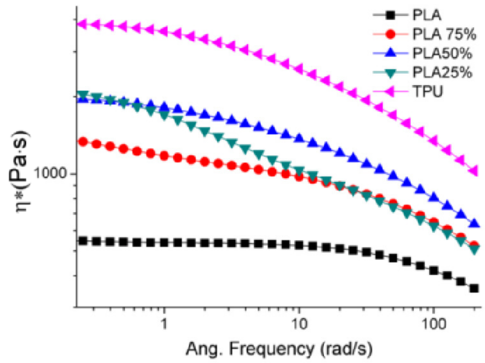

Figure 9. Complex viscosity of pure materials and blends.

small spheres at a content of 25% or large spheres at a content of 75% in the TPU matrix. At a content of 50%, it formed into both spheres and islands, which increased the surface roughness of cells. Mechanical tests confirmed the large tensile and compressive ranges of the scaffolds fabricated by microcellular injection molding, which may be potentially used in multiple tissue applications. The elongation-at-break improved dramatically as the TPU content increased in the blends. The fabricated scaffold had a highly porous. The tiny dispersed PLA spheres in the TPU matrix at 25%PLA significantly reinforced the blends at low temperatures or deformation frequencies.

Acknowledgements

The authors would like to acknowledge the support of the Chinese Scholarship Council and the Wisconsin Institute for Discovery, the financial support of the National Nature Science Foundation of China (No.51073061, No.21174044), the Fundamental Research Funds for the Central Universities (No.2011ZZ0011) and 973 Program (2012CB025902).

References

[1] R. Langer, J.P. Vacanti, Science, 260, 920-926 (1993).

[2] Y.Z. Zhang, J. Venugopal, Z.M. Huang, C.T. Lim, S. Ramakrishna, Biomacromolecules, 6, 2583-2589 (2005).

[3] X.W. Wang, P. Lin, Q.H. Yao, C.Y. Chen, World J Surg, 31, 682-689 (2007).

[4] S.H. Oh, S.G. Kang, E.S. Kim, S.H. Cho, J.H. Lee, Biomaterials, 24, 4011-4021 (2003).

[5] S.F. Yang, K.F. Leong, Z.H. Du, C.K. Chua, Tissue Eng, 7, 679-689 (2001).

[6] J.S. Son, G. Teja, M. Appleford, J.L. Ong, K. Park, D.K. Han, S. Oh, Tissue Eng Regen Med, 6, 1241-1251 (2009).

[7] S.D. Wang, Y.Z. Zhang, G.B. Yin, H.W. Wang, Z.H. Dong, J Appl Polym Sci, 113, 2675-2682 (2009).

[8] C.H. Lohmann, Z. Schwartz, G.G. Niederauer, D.L. Carnes, D.D. Dean, B.B. Boyan, Biomaterials, 21, 49-61 (2000).

[9] S.A. Guelcher, Tissue Eng Pt B-Rev, 14, 3-17 (2008).

[10] A. Burke, N. Hasirci, Adv Exp Med Biol, 553, 83-101 (2004).

[11] A.G. Mikos, A.J. Thorsen, L.A. Czerwonka, Y. Bao, R. Langer, D.N. Winslow, J.P. Vacanti, Polymer, 35, 1068-1077 (1994).

[12] L. Wang, J. Shi, L. Liu, E. Secret, Y. Chen, Microelectron Eng, 88, 1718-1721 (2011).

[13] S.A. Park, H.J. Kim, S.H. Lee, J.H. Lee, H.K. Kim, T.R. Yoon, W. Kim, Polym Eng Sci, 51, 1883-1890 (2011).

[14] Y.M. Corre, A. Maazouz, J. Duchet, J. Reignier, J Supercrit Fluid, 58, 177-188 (2011).

[15] A. Kramschuster, L.S. Turng, J Biomed Mater Res B, 92B, 366-376 (2010).

Upper Midwest Section hosts American Injection Molding (AIM) Institute for a Successful MINITEC

Our Upper Midwest Section hosted a very successful MiniTec this spring. The MiniTec, entitled “Knowledge is the Catalyst of Growth”, was held on April 21th at the Hennepin Technical College in Brooklyn Park, MN. The MiniTech featured speaker Dave Rose, from the AIM institute. The event attracted a total of close to 100 attendees including a combined 33 students from UW-Stout and Hennepin Technical College.

The seminar was followed by a networking event at Mad Jack’s and was very well received by those who attended.

We would like to thank our Program Chair, Sean Mertes, and Special Event Chair, Eric Swensied for organizing this event for us. Sean is already working on lining up more speakers in the areas injection molding, screw design and extrusion in the coming year. Please stay tuned!

A packed auditorium at the Spring MiniTech session presented by Dave Rose, AIM Institute

WHO CAN HELP YOU

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Councilor's Corner

Tom McNamara - Councilor - Upper Midwest Section

At our Council meeting prior to the ANTEC in Orlando, new officer positions of President-Elect and Vice President were elected. Scott Owens is our new President-Elect and Monika Verheij is a new Vice President. Dick Cameron has moved up from the previous President-Elect position to the SPE President position for the 2015-2016 operational year. Congratulations to all the new positon holders. A motion was also passed to approve the petitions for eight new student chapters. They are: Lamar University, North Carolina A&T State, Stevens Institute of Technology, Texas State Technical College, Texas State University San Marcos, University of Michigan Ann Arbor, UW-Platteville, University of North Texas.

A fair amount of time was spent on the governance structure of the SPE. The Council was broken out into eight subgroups to brainstorm options for restructure of the governance for more effective operation of our Society. The ideas from each group are being consolidated and action, if any is needed, will be discussed at the next Council meeting.

In my last report, I informed our UMW members of the addition of a new membership category called e-Member. It is a no cost membership with limited access to the many benefits of SPE full membership. Included on the following page is a breakdown of the various member benefits with indication of the privileges afforded each membership grade. The intent of the e-Membership is to allow some participation in the Society with the hopes that the e-Member will see enough benefit to encourage full membership at a later date.

As always, please contact me if you have any questions, suggestions, or comments on either the SPE International organization or our Upper Midwest Section. My contact information is on the back of this SPEcialist.

Benefit	Premium Member	Student Member	e-Member[1]	Honorary Member
Eligible to Join Sections & Divisions	✓	✓	No	No
Participate in SPE Voting / SPE Leadership	✓	✓	No	No
Use of SPE Member Logo	✓	✓	No	No
Discounts on SPE Conferences	✓	✓	No	No
Access to Technical Library	✓	✓	No	No
Access to Abstracts of Papers in Technical Library	✓	✓	Read	Read
Access to SPE Member Directory	✓	✓	No	No
Listed in SPE Member Directory[2]	✓	✓	✓	✓
Receive PE Magazine (paper)	✓	✓	No[3]	No[3]
Receive PE Magazine (electronic)	✓	✓	No	No
Use of PE Magazine APP	✓	✓	✓	✓
Receive Industry e-mail (focused information)	✓	✓	No	No
Access to the Chain				
• Tech Talk	✓	✓	✓	✓
• Cafe	✓	✓	✓	✓
• Leadership Lane	✓[4]	✓[3]	No	No
• Career Central	✓	✓	Read[5]	Read[5]
• Campus Connection	Read[6]	✓	No	No
• Premium Places (Forums)[7]	✓	✓	No	No

[1] e-Members to be designated as such in the Member Directory
[2] Anyone can opt-out from the member directory list
[3] Yes for current issue, no access to older issues
[4] If serving as SPE Leader
[5] Public will have no access
[6] Full if SPE Member is serving as a Group Facilitator
[7] Planned for Future Release

SPE Education Committee - *Tom McNamara*

Our Upper Midwest Section is proud to report that we have selected and awarded four scholarships to four very deserving students. Two of the awards were Tony Norris Scholarship Awards (2-year degree programs) in the amount of $400 and two other awards were Jerome Formo Scholarship Awards (4-year degree programs) in the amount of $500.

Tony Norris Awards went to:

Amber Robeck, a Plastics Engineering Technology student at Hennepin Technical College. Amber is active in the SPE Student Chapter and last semester made the President's List at HTC. She is employed full time at D.S. Smith Worldwide Dispensers in Lester Prairie, MN while attending school full time. She is also active in fundraising programs including Special Olympics Minnesota. She aspires to be a manager or founder of a company involved with plastics.

Elias Hailetelemariam is also a Plastics Engineering Technology student at Hennepin Technical College. Elias works a full time job at Medtronic, a world class medical device manufacturer, while going to school at HTC full time. He has worked his way up from assembler to Senior Cell lead-person. Elias uses some of his income to support his parents in Africa. He volunteers time at the Minneapolis Community Library. Elias acknowledges the importance of the life saving devices that his manufacturer makes and he aspires to own an injection molding or thermoforming company in the future. (accepted by Dan Ralph, HTC Plastics Engineering Technology Program Manager)

Jerome Formo Awards went to:

Michael Beeler, a Plastics Engineering student at the University of Wisconsin – Stout. He has been a member of the UW-Stout SPE Student Chapter since 2012. He was elected Vice President of the Student Chapter for the 2015-2016 school year. Michael has done many volunteer activities including UW-Stout move-in, campus cleanup, and State Science Olympiad. He has worked as a Research Assistant in the UW-Plastics Laboratory and as a Laboratory Assistant helping to instruct other student in the use of all of the equipment in the UW-Stout Plastics Laboratory.

William Miller is also a student in the University of Wisconsin Plastics Engineering program. William has been awarded the UW-Stout Chancellor's Award for both his freshman and sophomore years. He was voted to the SPE Student Chapter Board of Directors and is active with many of the student activities. William has volunteered as coach of youth athletic programs in his community. He is an Engineering Intern at Profile Xtrusions in Neenah, WI where he is learning single extrusion, co-extrusion, and tri-extrusion. He has also worked as a Laboratory Assistant at the UW-Stout Plastics Laboratory. (accepted by Adam Kramschuster, UW-Stout Plastics Engineering Program Director)

UW-Stout 1ST Annual Golf Event

The University of Wisconsin – Stout held its first annual golf event in May at the Chippewa Valley Golf Course in Menomonie, WI. The event was organized by the UW-Stout Student Chapter. The event was considered very successful with many companies participating in the fun-filled day. The weather cooperated and even some of the golf "duffers" won prizes. Our Upper Midwest Section is the sponsoring Section for the UW-Stout Student Chapter and as such, we did sponsor a hole at the event and had some of our Section Board members attend. We look forward

SOCIETY OF PLASTICS ENGINEERS
Upper Midwest Section
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June 2015

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Upper Midwest Section Board of Directors 2014 - 2015

CALENDAR OF EVENTS

MINITECH.......................................June 23, 2015

GOLF OUTING...............................August 4, 2015

MEGATECH ....October, 2015

Upper Midwest Section (S22) Membership

April, 2015

Section Total 363