

SPE THE SPECIALIST

Minitech 2015

Tuesday, April 21, 2015 – 12:30 pm registration. 1:00 pm – 5:00 pm presentation

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

More information and to register: www.uppermidwestspe.org

Knowledge is the Catalyst of Growth

DAVID M. ROSE – INSTRUCTOR • AMERICAN INJECTION MOLDING INSTITUTE

What do Plastics Engineers and Managers need to do to be successful? What separates your company from your competitors? During this Mini-Tech we will explore some of the intrinsic interactions between the material, part design, mold design, and injection molding process. This will be an executive overview of some key plastics engineering principles and will cover such topics as; Shrink & Warp, Mold Cooling, and a New Look at Process Optimization.

The newly formed American Injection Molding (AIM) Institute has brought some of the top minds in the industry together to fulfill the industry need for multi-topical, integrated content with an emphasis science, plastics engineering, and technology. The AIM Institute provides a range of educational programs including: comprehensive Certification, shorter duration Professional Development, and Mold Filling Simulation.



David Rose of the American Injection Molding Institute "AIM Institute" David holds an Associate degree in Mechanical Engineering Technology and a Bachelor's degree in Plastics Engineering Technology. Prior to his current role at the AIM institute, Dave held the position of Director, Strategic & Corporate Accounts, and Manager of Technical sales at Beaumont Technologies, Inc., Erie, PA. He also worked for the Plastics Technology Deployment Center, at Penn State Erie, The Behrend College, Erie, PA as a Project Engineer for product development and tooling/process support. Prior to Penn State he worked as an Engineering Manager for Composiflex also located in Erie, PA. Prior to Composiflex, he worked at Fisher-Price in New York. In addition to technical sales, he has experience in new product development, tooling and process development, and project management. His experiences have afforded him the opportunity to work with both thermoplastic and thermosetting composite materials such as Kevlar and carbon fiber epoxies. Other experienced areas include injection molding, gas-assist molding, extrusion blow molding, and resin transfer along with tooling knowledge for each of these processes. Dave has also authored a number of technical papers which have been presented at various technical conferences within the plastics and rubber industries.

COST:

Advanced Registration (Thru April 17 5:00 pm)

Member: \$25 • Non-Member: \$50 • Students: No Charge

Late Registration: April 18 - April 21 / At the door

Member: \$35 • Non-Member: \$60 • Students: \$5

REGISTRATION – (Credit Cards now accepted)

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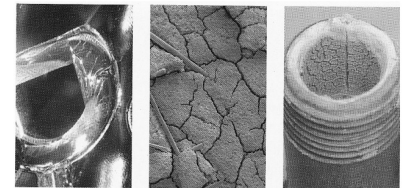
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President's Remarks *Shilpa Manjure*



This is our first SPEcialist for the year so Happy New Year to each of you and your families!! May the New Year be a healthy, happy and prosperous one. We are anticipating an active 2015 filled with several activities – Minitechs, MegaTech, Golf Outing, Plant tours, Scholarships!!

2014 ended with the Megatech event on November 11 on 3D Printing entitled “3D Printing From Evolution to Revolution”. This was co-hosted by the MN chapter of PDMA. Our Program Chairs Danny Mishek and Matt Havekost spearheaded the task of bringing together more than 120 attendees including several students. Thanks to Dunwoody College, Century College and Hennepin Tech for their active participation in this SPE event. Student education is an integral part of our objectives and we were extremely thrilled to see academia attendance in such large numbers. Thanks are also due to our Sponsors and Exhibitors for their support to the event. The speaker line up was well appreciated as they spoke about materials, design and machine. A free MakorBot give-away and the keynote by Jason Lopes linking Hollywood to 3D printing were probably the high-points of the day-seminar. A full story with photos has been included in the newsletter.

Our first event for 2015 was the Annual Meeting and Social held at the Acme Comedy Club on Feb 7th. Dr. Richard Bopp, retired Sr. Scientist at NatureWorks, was inducted into the UMW Hall of Fame for his many years of distinguished service to the Society and the Plastics Industry at this event. If you take a moment to review Dick's accomplishments, you will agree that his contributions were outstanding. Please do take a minute to congratulate him when you see him next for this very deserving honor he received.

In our previous SPEcialist we had promised that we would survey the membership so that we can bring to you education content that is of most interest. Thanks to all those who took the time to give us prompt feedback. We took note of your comments, interests and suggestions and our Program Chairs are already acting on these to plan a program for 2015. For those who didn't have a chance please feel free to reach out to myself or any of the board members listed on the back with your very important feedback.

Based on the survey results, Sean Mertes, our Program Co-Chair has put together a half-day of seminar on “Injection Molding Process Improvement Opportunities”. This will be held at Hennepin Tech in Brooklyn Park, MN on April 21st and will be followed by a networking event nearby. Please see details attached and mark your calendars for the afternoon.

Looking forward to meeting you at our next event. Happy 2015 again!

Sincerely, Shilpa

Award Dinner and Social



Sam McCord, Board Member, recognized for his contributions on the board.



Eric Cybulski, Board Member, recognized for his contributions on the board.



Eric Swensied, Special Events Chair, recognized for his contributions on the board.



Dr. Richard C. Bopp receiving the Hall of Fame Award.

Award Dinner and Social

Bill Suehr,
Chief Operating Officer at
NatureWorks, LLC.,
sharing his testimonials
for Dr. Bopp.



Dan Sawyer,
Global Leader, New
Business Segment at
NatureWorks, LLC.,
sharing his experiences
while working Dr. Bopp

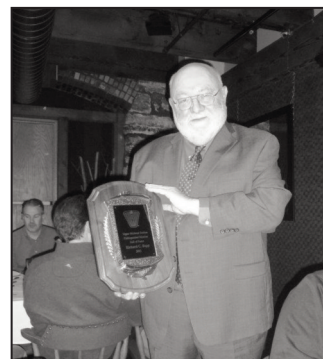


Dr. BOPP HONORED WITH HALL OF FAME by Shilpa Manjure

Dr. Richard C. Bopp was inducted into the Hall of Fame of the Upper Midwest SPE on February 7, 2015, at the 6th Annual Meeting and Social Ceremony, for his many years of distinguished service to the Society and the Plastics Industry. The ceremony was held at the Acme Comedy Club and was attended by 25 people including close friends, ex-colleagues from NatureWorks and co-board members of the UpperMidwest SPE. The guests of honor were: Dr. Bopp accompanied by his son, Tim Bopp, and daughter, Barbara Brabetz.

Bill Suehr, Chief Operating Officer, and Dan Sawyer, Global Leader, New Business Segment, at NatureWorks took us down memory lane as they shared work stories and how they admired Dick's passion for innovation, competence to solving problems, and his vast network at the SPE. The award ceremony was followed by a stand-up comedy show by Roy Woods Jr.

Dr. Bopp is a graduate of State University of New York and completed his doctorate at Rensselaer Polytechnic Institute (RPI). His work history includes: Polymer Development Chemist – General Electric Plastics Division (21 years) and Senior Materials Scientist – Cargill (8 years), NatureWorks (9 years). He is a member of the American Chemical Society, American Physical Society, Society of Plastics Engineers, and the Plastics Pioneers Association. In his service to the Society of Plastics Engineers, Dr. Bopp has held leadership positions as President of the Upper Midwest and the Hudson-Mohawk Sections, Councilor of the Plastics Environmental Division, and Director on the Board of the Engineering Properties and Structure Division.



Dr. Bopp has previously been presented the GE Plastics Don Jacquiss Award and the Technologist of the Year Award. He was also elected as a Fellow of the Society of Plastics Engineers, an award that is given to less than 5% of the total membership of the Society. His contributions to the plastics industry include: grants of more than 20 patents in polymer science and technology, development of environmentally friendly materials, and pioneering research in the fields of recycling and compostable plastic materials.

We are honored to have Dr. Bopp serve on the Upper Midwest Board! Congratulations!

SCIENCE CORNER

A COMPARISON OF THE RESIDENCE TIME IN MICRO-EXTRUDERS AND ITS EFFECT ON MOLECULAR WEIGHT FOR LOW OUTPUT APPLICATIONS

Kevin R. Slusarz, American Kuhne Inc., Ashaway, RI, USA

Abstract

This study investigates the residence time in micro extruders for low output applications. The micro extruders that were analyzed included extruder diameters between 12mm and 25.4mm. This study will show the effect of extruder screw speed on the residence time and compare that to theoretical calculations. Additionally, the study also demonstrates the change in molecular weight for a fixed output rate on the different extruder diameters.

Introduction

With the advent of new high performance materials and an increasing demand for less invasive medical devices the output rate requirements from the extruder system are becoming lower and lower. There are many references showing the current trends in the medical devices leading to these lower output requirements [1] [2] [3]. These trends include the increased demand for miniature catheters, multi-layer catheters, bioabsorbable resins and drug laced polymers.

The reason for the reduction in throughput can easily be seen when making smaller diameter catheters because the limiting factor when making small catheters, less than approximately 0.8mm OD, is typically line speed. There is a maximum line speed that can be achieved before handling of the tubes becomes problematic. Therefore, as the catheter size becomes smaller with a fixed maximum line speed the required rate is diminished.

There is also a trend to produce multi-layer catheters for a variety of reasons. With balloon catheters, physical properties can be enhanced using two or more layers of the same material as compared to a mono-layer catheter of the same dimensions. Other reasons for multi-layer catheters include using different polymers in contact with the drug going into the device on the inside of the catheter while needing properties of a different polymer on the outside where there is interaction with the patient. Therefore for a given catheter the required rate will be decreased based on the number of layers and layer ratios which is typically at least half as much for each layer compared to a mono-layer catheter.

Bioabsorbable and drug laced polymers pose some different challenges. First these materials tend to be very expensive and produced in very small batches. Because of this these devices tend to be made very small to minimize

the amount of material required. In addition to this these materials can be very temperature sensitive and will degrade when exposed to high temperatures for a long period of time (long residence time).

In all cases the medical device engineer designs the device around a particular material or materials and its properties. It is well known that if a polymer is exposed to elevated temperatures for a long time the material will start to degrade and this will affect the end properties of the material. Therefore it is important that the extrusion system is designed properly to minimize any changes to the polymer being processed.

Experimental

Residence time studies were performed on four different size extruders and the molecular weight was measured for a fixed output rate. The extruder diameters that were evaluated included a 12.0 mm, 12.7 mm, 19.0 mm, and 25.4 mm. Each extruder was fitted with a metering screw. The screw layout normalized by extruder diameter (L/D) and compression ratio of the meter depth to the feed depth is described in Table #1. Each extruder was setup with a breaker plate with no screens and a simple orifice die (0.89 mm diameter) with minimal volume. This was used in order to measure the residence time through the extruder at a nominal back pressure. For all the studies the same die and orifice was used.

Table #1 – Screw Designs (L/D)

Diameter (mm)	Feed (mm)	Transition (mm)	Meter (mm)	Compression Ratio
12.0	8.8	8.0	10.6	3.1
12.7	9.1	8.0	10.6	3.1
19.0	8.0	7.8	11.0	3.4
25.4	7.6	8.0	10.6	3.4

All the tests were performed under the same operating and drying conditions. The extruder barrel profile was: Zone #1 – 182°C, Zone #2 – 193°C, Zone #3 – 204°C, Clamp and Die Zones – 204°C. The feed section was controlled at 37°C. Since the materials used in this study are hydroscopic both materials were dried at 75°C for a minimum of 4 hours in a desiccant drier.

The residence time was measured by running the extruder at a fixed screw RPM and allowing to come to steady state. Once steady state was reached, samples were quenched in water and collected for molecular weight

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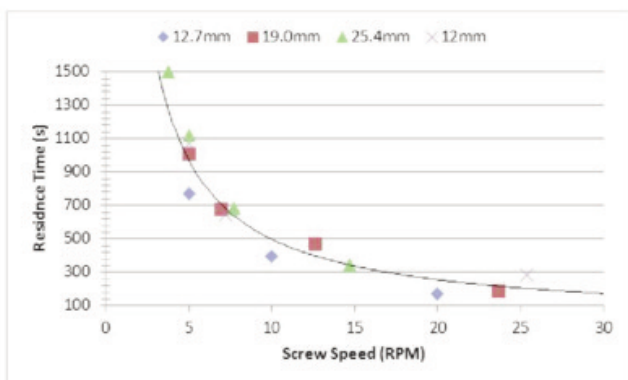


Figure #3 – Residence Time versus Screw Speed

$$T_r = 4588.6N^{-0.964} \quad (3)$$

T_r = Residence Time (sec), N = Screw RPM

Since the theoretical residence time and measured residence time showed a good agreement the slope of the residence time curve was plotted in Figure #4. It is observed that the slope of the residence time becomes increasingly steeper as the screw speed is reduced below screw speeds of 10 RPM.

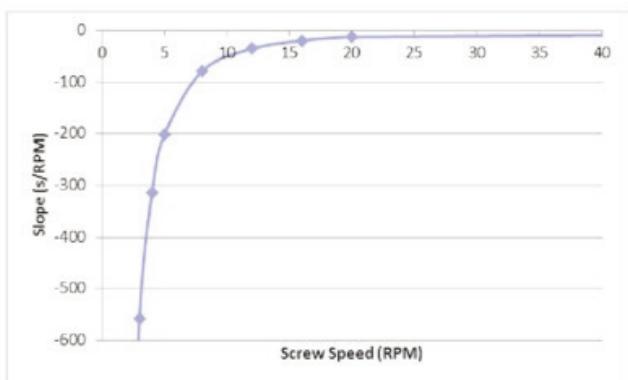


Figure #4 – Slope of Residence Time vs. Screw Speed

A comparison of the output rate versus residence time is shown in Figure #5. Taking data from this graph and evaluating a fixed output rate of 2.8 g/min yields Figure #6. As expected the residence time increased with increasing extruder diameter.

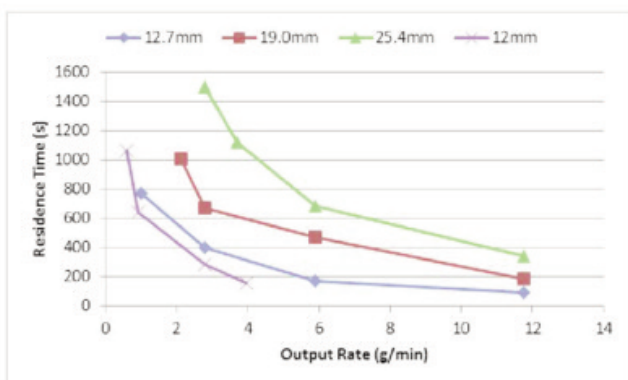


Figure #5 – Output Rate versus Residence Time

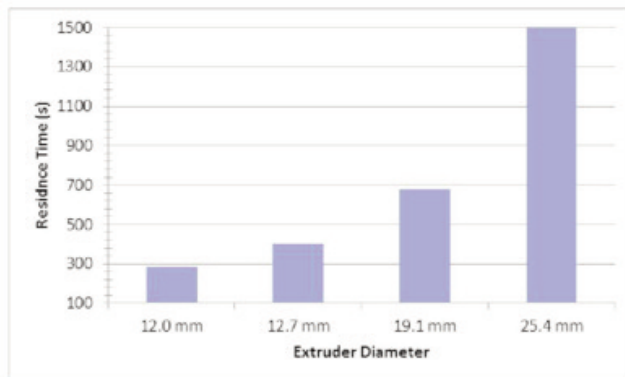


Figure #6 – Residence Time versus Extruder Diameter at 2.8 g/min

The final part of this investigation was to evaluate the effect of residence time on the molecular weight of the polymer. The resin that was selected is considered a very temperature stable resin. Figure #7 shows the weight average molecular weight (Mw), as measured by GPC, versus extruder size. For this study dried, un-extruded virgin pellets were used as the Control and the extrudate collected during the 2.8 g/min tests were analyzed. As the graph shows there is a deterioration in molecular weight as the residence time increases. There is approximately a 12% reduction in molecular weight for the 19.1 mm diameter extruder as compared to the control sample. The molecular weight reduction between the 12 mm and the 19.1 mm extruders was approximately 8%.

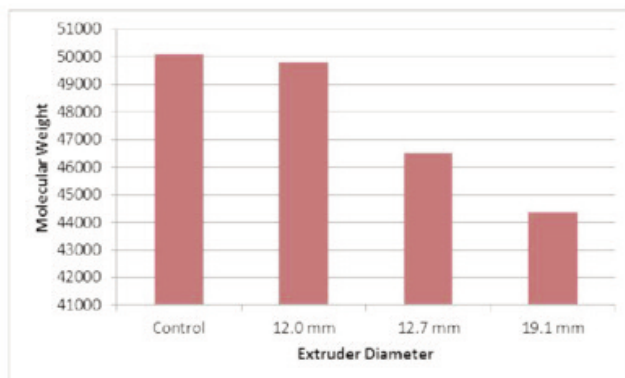


Figure #7 – Weight Average Molecular Weight versus Extruder Diameter at 2.8 g/min

Conclusions

This study compared the residence time versus extruder diameter for four small diameter extruders. It has shown that there is a very non-linear relationship between residence time and the extruder screw speed. For screws of different diameters that are scaled proportionally the relationship between residence time and screw speed is the same. When an extruder is operated at screw speeds

less than 10 RPM there is a significant increase in the residence time through the extruder because of this non-linear relationship as was shown in Figure #4.

The result of the GPC testing showed that for a very thermally stable polymer there is a significant change in the molecular weight as the residence time increases. This molecular weight shift will be more significant in less stable polymers such as the bioabsorbable resins.

Therefore, it is even more critical when an extruder is operated at screw speeds of 5 RPM or less, because there is a significant increase in the residence time through the extruder. Also operating in this non-linear range very slight changes in the screw speed will result in significantly different residence times. This can have a dramatic effect on the final product that is being produced. The material can be changing during a run resulting in product that may have varying properties throughout the run. In the case where a drug laden polymer is being processed, due to the drug's half-life at elevated temperature for extended time, this can result in different concentrations of the drug in the final product.



This paper has shown the importance of sizing the extruder diameter in order to maintain the integrity of the polymer that is going to be processed. Running oversized extruders can result in producing an end product that is either not consistent throughout the production run or may produce a product that differs from the originally intended physical properties that were designed into the final part. In addition to insuring that the extruder is properly sized for the output required all aspects of the extrusion system should be sized accordingly. Any piece of equipment that the polymer encounters during the molten phase needs to be sized to match the output rate in order to minimize residence time.


References

1. B. Doyle, D. R. Holmes Jr, *Medical Devices: Evidence and Research*, 2009:2, 47-55 (2009).
2. R. Ziembinski, *Medical Device Technology*, 20:3, 17 (2009).
3. S. Maxson, *Commercial Micro Manufacturing International*, 6:3, 20-23 (2013).
4. Z. Tadmor, C. Gogos, *Principles of Polymer Processing*, New York: John Wiley & Sons (1979).

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MEGA TECH 2014 WAS A GIANT SUCCESS!

With over 130 attendees, national renowned speakers and a great venue to host the event, people left excited about the 3D Printing arena. Presenters from two of the largest 3D Printing Manufactures (Stratasys & 3D Systems) shared current technology, software and materials and let us peek into the future where the industry was going. One of the highlighted presenters for Midwesterners was Jason Lopes (LegacyFX). He brought a different prospective to Mega Tech  on how 3D Printing was being used in Hollywood and in the Arts and Entertainment industry . It was great to see decorated successes from Ironman, Robocop, The Muppets, Avatar, and more!

The event was held at Century College and co-hosted with Century College and PDMA (Minnesota chapter). This was the first time that the local SPE and PDMA co-hosted an event.  It was nice to cross market and promote within each other's membership and share this success together. The diversity of attendees made for an exciting gathering. As if Mega Tech needed any more excitement, there was a Makerbot Mini 3D printer raffled off to an attendee donated by Stratasys. The lucky winner was a student from Dunwoody College - Dave Hofgren. Congratulations!!!

WHO CAN HELP YOU

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Councilor's Corner

Tom McNamara - Councilor - Upper Midwest Section

A major change that took place at SPE HQ was the retirement of the Managing Director of SPE and the SPE Foundation, Gail Bristol. Gail was the 'heart and soul' of SPE HQ. Gail was the pillar that held up the international headquarters and was the person that always made things happen. Gail spent 20 years in Field Services and then reinvigorated and expanded the SPE Foundation as its Director. Gail was awarded the Presidents Cup in 2008; bestowed by the SPE President to the person that has given significant service and support to SPE and our members. In 2014 Gail was awarded the most prestigious of all membership grades in SPE, that of 'Distinguished Member'. Only four people other than the Past Presidents have achieved this lofty distinction. After 33 years of service to our industry, Gail retired on September 1. We will sincerely miss Gail and wish her the very best in her retirement.

Replacing Gail is Russell Broome. Russ was active as a leader in the Piedmont-Coastal Section for almost 20 years on the international governance level since 1998. Russ was elected as the SPE Intl President in 2011. We wish Russell well in his new position as we know he has VERY big shoes to fill.

Other news from the Council meeting last Fall:

- A new social networking application called "The Chain" is being developed and implemented
- The new website is receiving about 1000 hits per day
- FY 2014 financials are tracking right with the approved budget
- The 2015 draft budget appears to be about break-even

Motions:

- To enable HQ and the Executive Committee to start an e-Subscription (not a membership per se, but free) with very limited access to SPE benefits, with the intent that those people who subscribe will see enough potential value to join at some paid-membership level. (Passed)
- To allow the use of the red logo, as well as the green and grey logos, as symbols of corporate identity. (passed)

Miscellaneous:

Just a reminder, ANTEC® 2015 will be co-located with NPE and held in Orlando, Florida, at the Orange County Convention Center. ANTEC® will be held March 23-25; NPE will be held March 23-27. ANTEC is the largest technical conference in the world dedicated specifically to plastics. The program will consist of 600+ technical and business presentations. It is a must for those that want to expand their knowledge and stay current on the newest technology and discoveries in the plastics industry.

Also remember, one benefit of SPE membership is the opportunity to connect with other professionals in our industry through LinkedIn. Membership in the LinkedIn® group of the Society of Plastics Engineers now exceeds 10,000; making it the largest group for plastics professionals on the LinkedIn social media platform. The SPE LinkedIn Group has become an industry resource for plastics professionals who are seeking answers to technical questions, networking, and even employment opportunities. You may join through the SPE website at www.4SPE.org.

And last but not least, I want to give my usual pitch for your help in growing our Section. If you are one of the members that have fallen delinquent on paying your dues, please submit them now. SPE offers many benefits that cannot be obtained elsewhere. If you are a member in good standing, please recruit your colleagues. We as a Board are working hard to provide the educational and network benefits that you expect from a professional organization. We can only become better with your help!!

SPE Education Committee - Tom McNamara

Our Upper Midwest Section is proud to report that we have selected and awarded two scholarships to two very deserving students. The two awards were both Tony Norris Scholarship Awards in the amount of \$400.

The first recipient was Maureen O'Hern of Hennepin Technical College. Maureen is enrolled in Manufacturing Engineering Technology concentrating in the Plastics Engineering A.A.S. degree program. Maureen has been on the HTC President's List since the fall of 2012, is a Phi Theta Kappa member, and was the SPE Student Chapter Secretary in the spring of 2014. She has worked at Boston Scientific, Greatbatch Medical, and St. Jude Medical. Maureen is interested in the development of new medical devices.

The second Tony Norris Award recipient is Joshua Roettger, also a student at HTC. Joshua is also enrolled in the Plastics Engineering Technology A.A.S. program. Joshua has held leadership positions in the SPE Student Chapter at HTC. He has worked at Aspen Research Corp as a Development Center Coordinator while working with twin screw extruders in compound formulation. He also has worked at Anderson Windows as an Associate Engineer in the materials department working on their Fibrex composite development. Joshua would like to become an expert in the compounding of plastics. Just a reminder to all students that are SPE student members enrolled in a plastics certificate or degree program, we have scholarships available that will be given out at our April 21 MiniTech. Applications must be turned in by April 9. Information and application forms may be found on our Section website: www.uppermidwestspe.org.

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 373 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		
Joseph Adams	University of Wisconsin-Stout, Spring Valley, WI	Cody Hovdet	Winona State University, Winona, MN
Mohamed Ahmed	Hennepin Tech College	Richard Hoverman	University of Wisconsin-Stout, Osceola, WI
Brandon Andrzejewski	University of Wisconsin, Lino, MN	Logan Jacobson	University of Wisconsin-Stout, Woodville, WI
Austin Bahr	University of Wisconsin-Stout, Bryant, WI	Kollie Jallah	
Michael Beeler	Menomonie, WI	Mariah Kestila	University of Wisconsin-Stout, Menomonie, WI
Jacob Bell	University of Wisconsin-Stout, Trego, WI	Kasey Kiel	University of Wisconsin-Stout, Menomonie, WI
Kristin Charlton	Midwest Prototyping	Alexander Kirsop	University of Wisconsin-Stout, Menomonie, WI
Tim Coates		Kyle Klein	University of Wisconsin-Stout, Menomonie, WI
Ben Davidson	Winona State University, Winona, MN	Ceanna Kollodge	University of Wisconsin-Stout, Menomonie, WI
Kevin Davidson	Winona State University	Dan Koughan	MN Rubber & Plastics
Ben Davidson	UW Stout	Katie Kozub	Clariant Corporation, Delano, MN
Meaway Diamond		Daniel Kuhnert	University of Wisconsin-Stout, Menomonie, WI
Brennan Druckrey	University of Wisconsin-Stout, Abrams, WI	Arun Kumar	Minnesota Rubber & Plastics, Plymouth, MN
Brandon Eid	University of Wisconsin-Stout, Cedar Lake, MN	Rachel Kusleika	
Kyle Flaten	University of WI-Stout, Menomonie, WI	Erica Kylo	3M Corporate Research, St Paul, MN
Kevin Fuhrman	UW-Stout, Menomonie, WI	Josh Moreland	University of Wisconsin-Stout, Menomonie, WI
Darin Gullickson	University of Wisconsin-Stout, Chippewa Falls, WI	Jake Mulligan	Teel Plastics
Austin Haglund	University of Wisconsin-Stout, Menomonie, WI	Tyler Naatz	University of Wisconsin-Stout, Menomonie, WI
		Juan Nieves	
		Maureen O'Hern	
		Tyler Pederstuen	Student Member, Winona, MN
		Paula Pierce	
		Jacob Rutkowski	University of Wisconsin-Stout, Hartford, WI
		Andrew Schaitel	University of Wisconsin-Stout, Menomonie, WI
		Ken Schomburg	Satellite Industries, Minneapolis, MN
		Zachary Schulz	University of Wisconsin-Stout, Menomonie, WI
		James Shablow	University of Wisconsin-Stout, Saint Paul, MN
		Eric Shay	
		Joseph Sherry	Student Member, Winona, MN
		Trevor Sobtzak	Student Member, Mahtomedi, MN
		Eric Swensied	Harbor Plastics, Maple Plain, MN
		Todd Tollefson	University of Wisconsin-Stout, Manitowoc, WI
		Jaker Vittorio	Stratasy Inc.
		Logan Worm	Bobcat, Bismarck, ND
		Erin Yee	Andersen Corporation, Minneapolis, MN
		Jodi Zawaski	
		Andrew Zuis	



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Newsletter

April 2015

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CALENDAR OF EVENTS

GO OUTING.....August, 2015

ANTEC / NPE.....April 21, 2015

Upper Midwest Section (S22) Membership

March, 2015

Section Total 373