SPE SOUTHERN CALIFORNIA

The SPE Press

www.socalspe.org June 2016

The Southern California Section of the Society of Plastics Engineers
Local information on resources and education available to plastics professionals

33rd Annual Golf Tournament

Date: Thursday, June 23, 2016

Sierra La Verne Country Club
6300 Country Club Drive
La Verne, Ca. 91750
909.596.2100

Registration: 7:30 a.m.

Register Now!

Download Event PDF

Register online NOW!

Our Golfers will enjoy our return to the exclusive Sierra La Verne Country Club. Located in the rolling foothills of the majestic San Gabriel Mountains, the course offers a cool climate surrounded by great natural beauty. We have an early morning shotgun start at 7:30AM. Event proceeds help support the SoCal SPE education and scholarship programs. Join in after the tournament for the golf awards presentation and luncheon after golf. This year, Sierra Lavern has given us a discount so we may lower the entrance fee to $99.00 per player.

We are asking for Tee sponsors for this Year's Tournament. We would like to thank last year's Tee Sponsors. Many are doing so this year. We especially thank Craftech for the Tee and Flag sponsorship. All of the funds go directly to the Scholarship, High school essays and student admissions to our events.

New this year: Rusty Miller perpetual trophy (The Rusty) for the low score foursome. Be the first to have your name engraved on the trophy. If the foursome is sponsored by a company, will also engrave the company name with the player's name. That includes suppliers and guest such as (GE, DuPont, and Toshiba. Borche, Etc,). Come and support us in honoring Rusty.

Past SPE presidents are invited for our traditional informal past presidents meeting

SPE Southern California is also looking for an event sponsor. The tournament will be named after this sponsor. The (ABC Inc.) 33rd Annual Golf Tournament for Plastic Education. A $3000 donation with a commitment for 3 years is all that is needed to be the event sponsor. Please Call Kerry Kanbara, 909.906.2332 for more details.

Any donations in the form of Raffle Prizes, Tee Sponsorship, Cash or Services for this fundraiser will be greatly appreciated. Your contribution will be recognized at the tournament.
Event coordinators:
Kerry Kanbara 909 906 2332

PRESIDENT'S MESSAGE

We have had a successful Molding Workshop held in April at the Engel Technology Center. The seminars were well received and from the feedback we've received, everyone was pleased with the workshop. On behalf of SoCal SPE we would like to thank Markus Lettau and Engel Machinery Inc. for hosting this event.

It is amazing how quickly this year has passed! June is already here and it is a great month with beautiful weather for our 33rd Annual Golf Tournament for Plastics Education. So it is time to dust off your golf clubs and hit the golf range. Tee and flag sponsorships as well as donation for raffle prizes are welcome and greatly appreciated. As you know for 33 years the SoCal SPE has hosted this event and proceeds from the event has helped to maintain the goals to promote plastics education. We are looking forward to see everyone at this event on June 23rd at the Sierra La Vern Country Club. More details on this golf outing are on our website.

Another major event is also approaching: The annual Western Plastics Trade Fair to be held on August 11th at the Phoenix Club in Anaheim. This is an exciting annual event with opportunities to network, reaching out to prospects, introducing your company and products. This day-long event will include technical seminars, vendor displays, food and lots of raffle prizes. We encourage everyone to mark their calendar for August 11th and joint us in this event.

We look forward to seeing you at one of our many upcoming events.

Tuan Dao
President, SoCal SPE
(714) 692-9492

Advertise with SoCal SPE

SO Cal SPE Newsletter Ad rates 2016

Ad size	Specs.	Size (inches)	Cost per issue	Yearly (12)
Business Card	Horizontal	2 (h) x 3.5 (w)	$45	$540
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Double	Vertical	7 (w) x 2 (h)	$90	$1,080
Triple	Vertical	2 (w) x 10 (h)	$135	$1,620
Half page	Horizontal	7 (w) x 5 (h)	$150	$1,800
Full Page		7 (w) x 10 (h)	$250	$3,000

Sample issue at www.socalspe.org

Contact: Michael Espinosa: michael@trianglesalesinc.com

MEMBERSHIP SPOTLIGHT

SoCal SPE Wants YOU to Become a Member

The SPE Southern California Section is, for a limited time, offering one FREE registration to a single, exclusive local technical event for those who sign up for an SPE Membership! To be eligible for this special offer, visit our website @ socalspe.org to check out the event calendar and register as an SPE Member! Once a member, you will be sent a voucher to bring to the SoCal SPE event of your choice! Offer also applies to expired memberships. Don't let this opportunity pass you by, become an SPE member today!

For questions, contact Ashley Price at 562-217-1377 or aprice@ethorn.com.

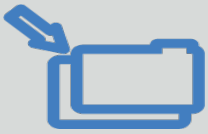
SAVE THE DATE

George Epstein Scholarship Award

The **George Epstein Scholarship Award** was established in 1984 as a tribute to his many contributions to plastics both commercially and educationally. Since inception, the Southern California SPE Section has awarder over $33,000.00 in scholarships. The award is open to student members or son/daughter, grandsons/granddaughters of a member in good standing of the Society of Plastics Engineers, Southern California Section.

QUALIFICATIONS

1) Son/daughter or grandsons/ granddaughters of a member or a current student member in good standing of the Society of Plastics Engineers, Southern California Section.
2) Applicants must have a demonstrated or expressed interest in the plastics industry.
3) An Applicant must be in good academic standing at his/ hers school.
4) High School graduating senior accepted to a University or Jr. College.
5) Matriculating undergraduate student at a University College or Jr. College.
6) Matriculating graduate student at a University College.



APPLICATIONS

Applications must include the following minimum information:

- Name and relationship to the member of SPE
- Address, phone number and email address (if available)
- Institution attending and Student ID number
- GPA, SAT, Major, Goals, Awards, Clubs,Activities, Achievements, Hobbies
- Include any additional information that would assist the selection committee.

LATE APPLICATIONS

Late applications and those that do not include the above information as a minimum will not be considered.

$250 & $500 scholarships are available and will be awarded based on the above criteria and Scholarship Committee evaluation of the effort put into the application, format, grammar, spelling, etc., the applicants ability to express him/herself in writing and subjective evaluation of applicants activities in/out of school and awards and achievements. SoCal SPE reserves the right not to award a scholarship in a given year if it so chooses.

For more information email - socalspe@gmail.com
Entry Deadline: May 31st
Awards are presented at the banquet following our Annual Golf Tournament for Plastics Education

Additional scholarships are available through The SPE Foundation Scholarship Program.
For more information click here.

Scientific Molding: An Introduction and 11 Simple Steps to implementation

Sachin Kulkarni, Fimmtech

Injection molding is one of the most common techniques employed in the manufacture of plastic products. Injection molding of plastics began as an idea by the Hyatt brother for the manufacture of billiard balls in the late 1800s and has evolved to a much complex operation in recent years. This evolution is being driven by a variety of forces. The need for complex parts with tighter tolerances, the types of materials, the implementation statistical quality concepts have all been some of the driving factors for this advance. Although the basic process of injection molding has remained the same, over the last couple decades the application of certain scientific principles has led to a better understanding of the process. This understanding has helped to make the processes robust, predictable and efficient.

The actual injection molding process has been traditionally defined as the inputs to the molding machine. Injection speeds, pressures, temperatures and times are examples of these and are recorded on what is called a Process Sheet. However, the word process now needs to be redefined as the complete operation that encompasses all the activities the plastic is subjected to, inside a molding facility – form when the plastic enters the molding facility as a pellet to when it leaves the facility as a molded part. For example, the storage is the plastic, the control of the drying of the plastic and the post mold shrinkage of the part can have a significant influence on the quality of the part. To control the quality of the part, every stage must be understood. Molding a part that meets the quality requirements is easy but molding parts consistently is the real challenge.

Process Robustness and Consistency: The aim of developing a molding process should be to develop robust processes that would not need any process modifications once the processes are set. Process consistency leads to quality consistency. There are three types of consistencies, cavity to cavity consistency, shot to shot consistency and run to run consistency. Cavity to cavity consistency is required in multicavity molds so that the quality of each cavity is identical. Shot to shot would mean that every consecutive shot would be of identical quality to the previous shot. When the process parameters from two different runs were identical and they produced the identical quality parts, then this is called run to run consistency. Robust and stable processes always yield parts with consistent quality with one established process.

The 11+2 Molding Parameters.

Refer to Figure 1. There are 11+2 plastic molding parameters that influence the part quality. Settings such as mold open speed are not considered as plastic molding parameters because they do not influence part quality. In most molding processes, only 1 second stage pressure is used and is called the holding pressure. If the concept of pack and hold is applied, then we add the additional two parameters or pack pressure and pack time. Hence they are 11+2 molding parameters. Suck back (Decompression) should only be used to decompress the melt and hence that should not be considered a plastic molding parameter.

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The 11+2 Molding Parameters
1. Melt Temperature
2. Mold Temperature
3. Shot Size
4. Transfer (Cut off position)
5. Injection Pressure
6. Injection Speed
7. Pack Pressure (Not always used)
8. Pack Time (Not always used)
9. Hold Pressure
10. Hold Time
11. Cooling Time
12. Back Pressure
13. Screw Speed
All these must be optimized to produce acceptable parts and have robust processes.

Scientific Molding: Scientific Molding is a technique used to optimize the molding process. The term Scientific Processing is a wider term that encompasses all the involved processes from when the plastic enters the molding facility as a pellet to when it exits as a finished part.
Scientific Molding is a subset of Scientific Processing and is related to the studies and optimizations carried out at the molding machine. There are six steps that are used to optimize the molding process. For detailed info and procedures please visit www.fimmtech.com and request free information. The six steps are as follows. Refer to Figures 2 to 7
1. Rheology Study or Viscosity Study: A graph of the plastic viscosity is generated at the molding machine with the mold and the material under consideration. The viscosity remains fairly constant at higher injection speeds. The injection speed is set to a value in this section so that variations in the injection speeds have very little effect on the viscosity assuring a consistent fill.
2. Cavity Balance: A graph of the weights of short shots from of all the cavities provides the information about the balance of fill between the cavities. A balanced fill between cavities will ensure equal amount of packing of material into the cavities resulting in cavity to cavity consistency.
3. Pressure Drop Studies: A pressure drop study is done to ensure that the screw has enough pressure to move at the set speed. When more than the available pressure is required the screw slows down and the cavity fill becomes inconsistent. Such processes are called pressure limited processes.
4. Process Window Study: The process window study is performed to find the limits between which cosmetically acceptable parts can be molded. Typically, the two variables are holding pressure and melt or mold temperature. A center pressure is the most desirable setting that again compensates for the natural variations in the holding pressures.
5. Gate Seal Study: As the plastic fills the mold through the gate, the velocity reduces, it cools down and eventually the gate freezes off. Pressure must be applied to the screw till the gate freezes off to maintain cavity pressure consistency and part weight consistency.
6. Cooling Time Study: A cooling time study is performed to find out how fast can a part be molded without any distortion or any other issues. Since the parts are available, a graph of the important dimensions can be plotted as a function of the cooling time.

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The six step process above is a process optimizing technique and not a dimension optimization technique. The goal is to establish a robust process regardless of the dimensions. Once the process is robust and stable the steel must be adjusted to get the parts within the required specifications. This is the reason why most mold makers keep the steel 'safe' and recut the steel after the process is developed. Molders should perform a Design of Experiments to optimize the molding process and the mold for dimensions.

Design of Experiments (DOE): A designed experiment is nothing but a systematic study of the effect of the variables on the quality of the part. DOEs have been traditionally used in injection molding for the following reasons:
1. To pin point a process that can be used to make parts with the required specifications.
2. To find the robustness of the process by varying the process around a set process.
3. To find the effect of each variable on the quality of the part.
The Complete Mold Qualification: Refer to the Flow Chart in Figure 8. There should be two stages of the Mold Qualification process. The first stage is to make sure that the mold can produce parts with consistent quality. Even if the dimension is out of specifications as long as the variation is acceptable, the process is considered as robust. The mold dimension can be now changed with confidence at this point if required. However, the second stage of using the technique of DOE helps in understanding the process better and helps in making better decisions.
The above techniques can be overwhelming to most molders who are looking for the benefits but do not have the resources to implement it. There is also a factor of 'Will this all work?' or will it be a waste of resources. For this reason, the author who has been practicing these techniques for the last 23 years has come up with the most basic steps to implementing Scientific Molding in a production environment. For detailed procedures, please visit the author's website given at the end of this article.

11 Easy Steps to Implement Basic Scientific Molding for optimizing the 11 parameters.
Scientific Molding is understanding why you are setting a molding parameter at a certain value. Keeping that in mind and noting that the following is an example only, please read on. Please consider modifying the parameter values below depending on the plastic, the part dimensions and other factors.
Consider a part that is about 150 mm in length and about 50 mm in width with a sub gate of 1.2 mm. The part wall thickness is 3 mm. The material being molded is ABS.

1. Set the mold temperatures and melt temperatures in the center of the recommended values.
2. Calculate the approximate required shot size using a formula or using the Scientific Molding App available for free for Android and iPhones.
3. Set the injection pressure to about 50% of max available pressure. During Step 8 watch to see if the actual is reaching this set pressure. If it is, keep raising it till the set is more than the actual.
4. Set injection speeds to about 50mm/sec or about 2 in/sec.
5. Set the cooling time to 20 seconds.
6. Set the back pressure to about 750 plastic psi.
7. Set screw rpms to between 50 and 100.
8. Set the pack and hold times to zero seconds and add a charge delay (Screw recovery) time of 5 seconds (Refer to website for reason why?)

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9. Start molding parts and adjust the transfer position such that the part is about 95 to 98 % full. It should look slightly short; the actual % number does not matter.
10. Add a total of 6 seconds of hold time (second stage).
11. Setting of Holding Pressure:
    a. Start increasing the holding pressure and note the point where the part looks cosmetically acceptable. Call this as Pressure P1
    b. Keep increasing the holding pressure to a point where you will get a defect such as flash on the part. Call this as P2. NOTE: The difference in the pressures (P2 – P1) should not exceed 4500 plastic psi. If no defect is seen after raising the pressure to P1+4500 = P2, then P2 should be taken as the high limit. P1 and P2 are now the lower and upper limits.
    c. Set the final holding pressure to the center of the two.

Why the above steps are considered as Scientific Molding?
Scientific molding is not following a set of procedures but applying and understanding the science behind molding. For example, we have set mold temperatures to a certain value for the above ABS because it is an amorphous material and needs good mold temps to get a good surface finish. The higher the temperatures, the better the surface finish but also higher will be the cooling time. Understanding and striking the balance is Scientific Molding. The mold was filled up to about 95 to 98% full and then taken into the second stage. By doing this, one is avoiding overpacking the cavity in the fill stage and then compensating for the shrinkage by adding plastic under the required pressure. The second stage pressure was set based on a quick one factor 2 level DOE (Hold pressure with high and low) and the center was taken as the most robust setting. This again is Scientific Molding.

The steps above are a good start to gain confidence about Scientific Molding. By no means is this a complete procedure and this article should be taken as a primer only.

For more information contact: Sachin Kulkarni by email at sachin@fimmtech.com.
Website: www.fimmtech.com.

About the author:

Suhas Kulkarni is the President of FIMMTECH, a consulting firm that specializes in services related to injection molding. He earned his Masters in Plastics Engineering from the University of Massachusetts, Lowell and a Bachelors in Polymer Engineering from MIT, Pune. He has 23 years of experience as a process engineer. His main area of expertise is Scientific Processing for Injection Molding. Based on his experience, he has developed a custom software called Nautilus, that aids the complete process development routine to production release. He also teaches a plastics and molding course at the University of California, San Diego and is a contract faculty at the University of Massachusetts at Lowell.

He is also an author of the book 'Robust Process Development and Scientific Molding' published by Hanser Publications

The Chain is a new online community platform developed by the Society of Plastics Engineers to enhance networking and collaboration with plastics professionals around the world. It provides tools for individuals to share information, ask for help, discuss problems, exchange lessons learned, search for information… or simply stay connected with colleagues in the industry.

People logging into The Chain are given access to all of these features and more—and they've been joining and logging in at a fast rate since the platform officially came online in early 2015.

Tech Talk is by far the most popular forum. Plastics professionals from around the world are coming together to discuss current issues felt by many engineers, exchanging ideas on how to tackle these problems moving forward. As Tech Talk becomes more well-known and popular this will be the premier source of information and trouble-shooting for plastics professionals around the world. Tech Talk is proving to be the Place where members can go for help solving problems, making recommendations, and general industry knowledge on a variety of technical topics. There are currently numerous ongoing discussions covering subject matter ranging from material applications, testing methods, and operational challenges to industry innovations.

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At the NPE show in March, SPE launched a free "e-Membership"—available to any professional with an interest in plastics and polymers. The e-Membership gives an individual full access to Tech Talk and SPE Café, and read-only access to the Career Central forum. All of these benefits are free as part of the SPE e-Membership.

Individuals also have the option of a Premium membership, which provides full access to all of the forums in The Chain, access to the largest technical library in the plastics industry, networking access to 20,000+ contacts worldwide, registration discounts to SPE conferences, subscription to Plastics Engineering magazine, and so much more, for the traditional yearly magazine, and so much more, for the traditional yearly rate.

With the official opening to the world-wide plastics industry, SPE expects this platform to grow exponentially in the coming years as the reference platform for plastics technology. Expectations are that in the near future people will say: "You have a technical issue in plastics? Go to The Chain and you'll find the answer!"

"I DECIDED TO GO ON THE CHAIN AND POST A TECHNICAL QUESTION ABOUT AN ISSUE/ PROBLEM WE ARE TRYING TO SOLVE ABOUT A PRODUCT.... I HAVE TO SAY THAT THE RESPONSE HAS BEEN FANTASTIC. NOT ONLY DID PEOPLE RESPOND WITHIN THE CHAIN AND POST THEIR COMMENTS AND SUGGESTIONS, I RECEIVED EMAILS AND ALSO PHONE CALLS FROM A VARIETY OF PEOPLE... THAT WERE WILLING TO OFFER UP POTENTIAL SOLUTIONS.... I AM HOOKED."—KIMBERLY RUSH DIRECTOR OF R&D AND REGULATORY, POLYFORM PRODUCTS CO. INC."

Check it out for yourself at http://thechain.4spe.org/home

UPCOMING COURSES

The College of the Extended University Cal Poly, Pomona

COLLEGE OF THE EXTENDED UNIVERSITY CAL POLY POMONA

Fall 2016

Scientific Injection Molding

COURSE CONTENT:

- *Polymer Basics, Plastics Materials and Flow Characteristics*
- *Part Design Fundamentals*
- *Overview of Basic Injection Molding Process*
- *Drying, Material Mixing, Coloring, Regrind Usage*
- *Major Process Variables*
- *Decoupled Molding, Universal Set Up Sheet*
- *Tooling Considerations, Venting, Cooling, Ejection*
- *Cycle Time Optimization and Troubleshooting Techniques*
- *Mold Flow Analysis*
- *How to Improve Productivity*
- *Modern Injection Molding Operation*

Plastics Engineering Technology Certificate Program

Dates: Saturday, September (TBD) 2016 **Time:** 8:00 AM to 5:00 PM
Location: Cal Poly Pomona
Instructor: Vishu H. Shah, Consultek Consulting Group www.consulteksa.com

The course emphasis is on scientific approach to a somewhat complex injection molding process in order to simplify and eliminate basic misunderstanding about processing techniques employed today throughout the industry. Students will learn the importance of understanding polymer basics, material flow properties, viscosity-shear rate curve, and major plastics variables in molding, decoupled molding techniques, data analysis and interpretation.

The course will cover fundamental and scientific approaches to material drying, venting, cooling, use of regrind, how to prepare universal set-up sheet, cycle time optimization, tooling considerations, etc. Use of modern tools and techniques such as mold flow analysis, cavity pressure transducers, and data acquisition tools along with troubleshooting techniques will also be covered.

Registration by Telephone
Students may call the College of the Extended University at 909.869.2288 to be placed on the class roster; fees must be paid to guarantee a seat in any class. Students may register by telephone with MASTERCARD or VISA.
Registration by Internet:
www.ceu.csupomona.edu

For more information call:
College of the Extended University
909-869-2288
Or Instructor : Vishu Shah 909-465-6699

UC San Diego

PLASTIC ENGINEERING – PART DESIGN FOR INJECTION MOLDING
(Course Code AMES-40168) Section ID 116806

University of California – San Diego, Extension.
July 16 – August 20, 2016

Expanding Skills in Plastic Part Design for Injection Molding
Plastics have increased their penetration of engineering applications that push the limits of part design, molding techniques and processing ranges. Plastic parts, often complex and large, are calling for better quality control and dimensional tolerances. Resin families and compositional variations have proliferated. Growth in the plastics industry has led to a constant influx of new people from other technologies who need to begin developing skills in the field of engineering plastics. People working in the industry need a good working knowledge of plastic part design.

Who Should Attend?
The course is primarily for designers, engineers, and technicians directly involved with making parts out of plastics. However, those in related activities ranging from management, purchasing, and quality control can benefit from the course by developing a better appreciation and understanding of the process of designing a plastic product.

Course Content
- Process of product design
- Fundamentals of plastics. Strength of materials, non linear considerations
- Materials selection in product design
- Molding and tooling considerations in part design
- General principles of part design. Short term loads, long term stress exposure
- Creep and relaxation in part design. Understanding safety factors in design.
- Dimensional analysis in part design
- Assembly techniques: design of snap-fit, press-fit, fasteners, ultrasonic, vibration welding, heat staking, adhesive bonding.
- Prototyping

Time/Dates: Saturdays, 9:30 AM-2:00 PM, July 16 – August 20, 2016 (6 mtgs)
Location: UC San Diego Extension. University City Center. UCC310
Contact: http://extension.ucsd.edu/ or Tony Babaian tbabaian@ucsd.edu

Instructor: Tuan Dao, MSME. Consultant, Polymer Engineering Group, Inc. Formerly with DuPont Co., Engineering Polymers, has 30+ years experience in part design, mold design and molding techniques.

SPE Southern California Leadership

SPE Leadership		
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Director: Matthew Dauphinee	909-947-7287	mdauphinee@missionplastics.com
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Society of Plastics Engineers
6 Berkshire Blvd., Suite 306
Bethel, CT 06801-1065 USA

Membership Application

PH: 203-775-0471 • Fax: 203-775-8490
www.4spe.org • membership@4spe.org

Contact Information *Please print clearly*

First Name (Given Name) Middle Name

Last Name (Family Name)

Company Name/University Name (if applicable)

Mailing Address is: ☐ Home ☐ Business Gender: ☐ Male ☐ Female (for demographic use only)

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The SPE Online Member Directory is included with membership. Your information is automatically included unless you indicate otherwise.

_____ Exclude my email address from the Online Membership Directory
_____ Exclude all my information from the Online Membership Directory
_____ Exclude my address from 3rd party mailings

By signing below, I agree to be governed by the Bylaws of the Society and to promote the objectives of the Society. I certify that statements made in the application are correct and I authorize SPE and its affiliates to use my phone, fax, address and email to contact me.

Signature _____ Date _____

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☐ Rotational Molding - D42
☐ Thermoforming - D25
☐ Thermoplastic Materials & Foams - D29
☐ Thermoset - D28
☐ Vinyl Plastics - D27

Geographic Section Member Groups - Network with local industry colleagues.

☐ Alabama/Georgia-Southern
☐ Asean*
☐ Australia-New Zealand
☐ Benelux
☐ Brazil
☐ California-Golden Gate
☐ California-Southern California
☐ Caribbean
☐ Carolinas
☐ Central Europe
☐ China
☐ Colorado-Rocky Mountain
☐ Connecticut
☐ Eastern New England
☐ France
☐ Hong Kong
☐ Illinois-Chicago
☐ India
☐ Indiana-Central Indiana
☐ Israel
☐ Italy
☐ Japan
☐ Kansas City
☐ Korea
☐ Louisiana-Gulf South Central
☐ Mexico-Centro
☐ Michigan-Detroit
☐ Michigan-Western Michigan
☐ Middle East
☐ Nebraska
☐ New Jersey-Palisades
☐ New York
☐ North Carolina-Piedmont Coastal
☐ Ohio-Akron
☐ Ohio-Cleveland
☐ Ohio-Miami Valley
☐ Ohio-Toledo
☐ Oklahoma
☐ Ontario
☐ Oregon-Columbia River
☐ Pennsylvania-Lehigh Valley
☐ Pennsylvania-Northwestern Pennsylvania
☐ Pennsylvania-Philadelphia
☐ Pennsylvania-Pittsburgh
☐ Pennsylvania-Susquehanna
☐ Portugal
☐ Quebec
☐ Spain
☐ Taiwan
☐ Tennessee-Smoky Mountain
☐ Tennessee Valley
☐ Texas-Central Texas
☐ Texas-Lower Rio Grande Valley
☐ Texas-North Texas
☐ Texas-South Texas
☐ Tri-State
☐ Turkey
☐ United Kingdom & Ireland
☐ Upper Midwest
☐ Utah-Great Salt Lake
☐ Virginia
☐ Washington-Pacific Northwest
☐ West Virginia-Southeastern Ohio
☐ Western New England
☐ Wisconsin-Milwaukee

*Asean: Indonesia, Malaysia, Phillipines, Singapore, Thailand, Cambodia, Laos & Vietnam

Special Interest Groups - Explore emerging science, technologies and practices shaping the plastics industry. Choose as many as you would like, at no charge.

☐ Advanced Manufacturing / 3D - 033
☐ Bioplastics - 028
☐ Failure Analysis & Prevention - 002
☐ Joining of Plastics & Composites - 012
☐ Marketing & Management - 029
☐ Non-Halogen Flame Retardant Tech. - 030
☐ Plastic Pipe & Fittings - 021
☐ Plastics Educators - 018
☐ Plastic in Building and Construction - 027
☐ Quality/Continuous Improvement - 005
☐ Radiation Processing of Polymers - 019
☐ Reaction Injection Molding - 032
☐ Thermoplastic Elastomers - 006

Recommended by (optional) _____ ID# _____

PE15