



EXTRUSION DIVISION NEWSLETTER

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A Message From the Chair



The past year and likely the next few years will be characterized by many changes for the Extrusion Division and the SPE as a whole. Many long time Board Members either are retiring, or will be retiring soon, so the torch must be effectively passed to the younger generation. As such, many long term paradigms and methods of operation may be challenged:

1. What are the goals of the Extrusion Division as a whole going forward?
2. What does the membership expect and how can we increase membership and participation in the SPE and the Extrusion Division?
3. How can we make membership in the SPE and participation on the Board a positive and rewarding experience?
4. What role will ANTEC play in the future and will it survive, and if so, how can we change the venue to attract more of the membership and be more cost effective?

It will not be possible to expand on all of these points in this message, but I would like to comment on a new strategy being directed at ANTEC this year. In the past few years the number of submitted technical papers has dropped significantly. While this presents a challenge, it also offers an opportunity to restructure our ANTEC offering. While there will always be a forum at ANTEC for new technology and an open invitation for the membership to submit technical papers, it is imperative that we adjust the offering to cover a broader range of information relevant to the needs of the membership. The membership has repeatedly told us that education in extrusion processes and equipment is important. In past ANTECs we have presented tutorial sessions with good success. That will not change and those sessions will also be presented at the 2017 ANTEC as well.

This year, Adam Dreiblat, the Extrusion Technical Program Chair, has initiated a new ANTEC program called “ask the experts”. This will be a pilot program directed at offering practical process information to the membership directly from the industry experts. In the future there will likely be other sessions offered that are not only directed at practical processing issues, but also directed at key technical areas in which the membership has indicated interest. The goal is to add value to ANTEC attendance for a broad spectrum of the membership.

Change is always difficult, but must continually be addressed if the SPE and the Extrusion Division is to survive and to grow. We are excited about the new “ask the experts” venue as well as the other new technically specific sessions that will evolve in the future.

We ask that the membership consider the value of attending ANTEC this year and in the coming years in light of the new programs and to actively express interest to the SPE leadership regarding areas of specific interest so that we can better tailor the program to your needs.

Dan Smith

SPE Extrusion Division Chair, 2016-2017

My Plastics Life

Hall of Famer reflects on six-decade career in the industry.

By Bob Barr



In 1957 after I was discharged from the Army I sought a job, preferably with a small machine manufacturer. I had received my mechanical engineering degree before I was drafted. As a result of my search I got a job as a Development Engineer with a small machine builder, John Waldron Corp., in New Brunswick, N.J. My boss was Tony Pomper, director of engineering. One project of interest was a machine to paint aluminum sheet which would then be formed into gutters and siding for houses. At that time a new thing! My first project there was to develop a mechanism to keep the aluminum sheet centered on the machine's rolls.

Shortly after I was hired I got a new boss, Charles Waechter. He had been in development at Union Carbide's Bound Brook, N.J. R&D facility. Union Carbide was one of the largest resin suppliers, bought out by Dow Chemical Co. in 2001. My next project was to develop a machine to insert post card size return mailers on newspaper printing presses, called an Adsert Machine. It was my first patent. For years, afterward you could see them in Parade magazine as a return post card to join, like the Columbia Record Club. Parade called it the "outsert" card.

Waldron was bought out by a much bigger conglomerate, Midland Ross Corp, who also bought a small plastic machinery company, Hartig Engine and Machine Co. Hartig had been started as a general machine shop after WWII by Ed Green. They made plastic extruders. I had no idea what an extruder was but I soon found out. One extruder was set up in the Waldron lab with an extrusion coating line. Charlie Waechter and I ran tests to extrusion coat printed sheets of paper with a thin plastic film. One use we worked on was for small packs of Sweet and Low sugar substitute. New then but very common now.

I was asked if I would like to be in charge of the Hartig R & D lab, which also served as a demo lab for their extruders. I took the job which was my start into my career in plastics machinery. That was in 1961 and the plastics industry was just in its infancy. Remember the film *The Graduate*, in which the boy's uncle advised him "Plastics! That's the future!" Well he was right! All kinds of crazy ideas led to a huge industry. Plastic film, like Glad Bags, bottles like milk bottles (Milk was still delivered to your doorstep in glass bottles then) plastic pipe, plastic insulated wire, and on and on. Now when I look back I see an exciting time and I was in at the beginning of the greatest growth period in that industry! I saw that the basic plastic extruder, which melted, mixed and pumped molten plastic was inherent to almost all of the processes that made plastic products!

So, I began to concentrate on the extruder and its key component, the extruder screw. My years in that lab brought me into contact with many of the prominent plastic industry engineers, scientists and companies. Although HDPE was the primary resin in that era,



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new materials like Polypropylene were being introduced during that period along with new processes to make plastic products. We ran an average of two trials a week for potential customers resulting in sales of our extruders and screws. I hired a young engineering student from Korea, Chan Chung, to work for me at the Hartig lab as a development engineer, later he obtained a Chemical Engineering doctorate while at Hartig and went on to become a leading theorist for the plastic industry through his work as the Chairman of the Plastics department at Rensselaer Polytechnic Institute which happened to have granted me my bachelor degree in mechanical engineering in 1954.

I also hired another engineer, John Antonopoulos, to help with our various projects. John later went on to be general manager of Kautex, a blow molding machinery company. Tony Pomper was a great advocate of his engineers being active in industry societies like TAPPI and SPE, so I joined the Society of Plastic Engineers, which had been formed in 1942, and began attending their monthly meetings at the Military Park Hotel in downtown Newark, N.J. I met many industry leaders there. Al Kaufman, founder and president of Prodex Extruders, was very innovative developing the 30:1 vented extruder and screw for processing rigid PVC powder into pipe and profiles. After Prodex was sold to HPM Corp., Frank Nissel, at the time the Prodex sales manager, left and started Welex, which became a leading worldwide manufacturer of sheet lines.

At the time there was also Egan Machinery, which made extrusion lines. Egan was started in 1946 by Frank Egan, former sales manager of John Waldron Corp. In the early-1960s Egan began making and licensing the reciprocating screw extruder for injection molding machines. Patented by another prominent name, Bill Willert, who had the patent on the reciprocating screw device for injection molding machines. Also at Egan was Bob Gregory, their development engineer, who became a leading screw designer. Egan was a very well-respected and active extrusion machinery company and was especially prominent in extrusion coating lines. Another coming name in extrusion was Lucien Yokana, who formed Sterling Extruder Co. in 1959 after leaving Hartig as their sales manager. Sterling went on to become a leading supplier of extrusion lines.

The Newark section of the SPE had become a hot bed of development for the plastic industry. I was privileged to associate with many of the members there. Soon they'd emerge as leaders of the plastics industry destined to fame. Bruce Maddock, a research engineer at Union Carbide's Bound Brook lab, made many contributions to the science of plastic extrusion. His experiments with screw pull outs led to his developing the solid bed theory of melting. Continuing his pioneering work were Zehev Tadmor and Imrich Kline who, at Western Electric's polymer research lab, originated the first mathematical modeling for the solid bed melting computer programs. Chan Chung and I visited them to help us develop our own computer programs for screw profile design. In those days, the late 1960s we had to use a networking computer at GE through a telex connection. A long and difficult process unlike today's ease with WIFI and the vast memory storage in our personal computers.

Let me elaborate a bit on the importance of Bruce Maddock's work to our industry. He was a thin, studious and quiet man, not prone to self-promotion. I visited him many times in Bound Brook. His work helped shape the future of extrusion. In addition to his pioneering work on the solid bed theory of melting, he also was the prime promoter of the now famous Maddock mixing head. First invented by one of Union Carbide's maintenance men, Gene LeRoy, it was designed and extensively tested and promoted by Bruce in Bound Brook. Improvements were made by many including Gregory of Egan, who adapted the spiral fluted mixing head

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version or Spiral Maddock. I would venture that well over half of all screws in production today have a Maddock mixing head on them.

The SPE also had annual meetings—the Annual Technical Conference or ANTEC. These were held in large cities where there were enough hotel accommodations for the 2000-3000 plastic engineers who attended from all over the world. As a member of the society I attended all of these for over 50 years. During much of that time I was the awards' chairman for the Extrusion Division. I gave several technical presentations at ANTEC and the local section meetings, usually about screw design. I was very lucky through these endeavors to meet and befriend most of the prominent engineers and inventors in the industry, such as Dr. George Kruder of HPM, Dr. Paul Squires of DuPont, Frank Nissel of Welex, Don Peters of Phillips Petroleum, Eldridge Mount and John Wagner of Mobil Chemical, Dr. Kun Hyun and Dr. Mark Spalding of Dow Chemical, Bill Willert and Bob Gregory of Egan, Bob Graham of Graham Engineering, Paul Colby and Jim Frankland of New Castle Industries...the list goes on and on. These men and many others led the fantastic technical growth of the Industry during the 1960s into the 1970s and beyond to the present.

An industry organization, The Society of the Plastics Industry or SPI, was formed in 1937. The members of this were not individuals but companies, mostly resin suppliers or manufacturers of plastics processing machinery. The SPI (now the Plastics Industry Association) holds a large exposition every three years: The NPE show. The first NPEs were held in New York City. However, the facilities there eventually were too small for the enormous number of companies that exhibited their products in assigned booths. At the time, more than 20,000 attended these exhibitions, so NPE was moved to the only facility able to hold all those booths and house the attendees: the Stock Yards amphitheater in Chicago. The show was eventually moved to McCormick Place in the mid-1960s and remained there until 2012, when it relocated to Orlando, Fla.

I began to travel extensively giving presentations all over the country at local SPE sections. These meetings usually had about 20 to 50 attendees and were held in all the major cities in America. I was mostly presenting my patent for what I called the BARR screw, which I had patented at Hartig as the first constant channel width barrier screw. It was this effort that made me well known in the industry, and to which I attribute my success. I must have made over 300 talks over a five-year period. As a result of these trips, in addition to many sales calls, I continued to meet many plastics industry movers and innovators: Leo Cancio, originally of Chevron Chemicals, now still active with Clopay Industries; and Russ Gould who had pioneered plastic strapping machinery and became its leading consultant.

The aforementioned Dr. Kruder of HPM was another famous screw designer and invented the popular Wave Screw. George was very active in SPE and was also an active member of the Extrusion Division for many years. He was a good man and a very good friend.

Hartig had entered the blow molding machinery market in the mid-1960s and went on to develop the ram accumulator type of blow molding machines with emphasis on medium to large part blow molding. I attribute Hartig's success to its Director of Engineering, Tony Pomper; its R&D director Charlie Waechter; hydraulics design engineer Lloyd Kovacs; and John Hsu, its best machine designer. Lloyd later went on to become vice president of Hayssen, which manufactured blow molding machines.

Under the direction of these men, Hartig pioneered blow molding machines to make 55 gallon drums, automotive gas tanks and many toy items. Marks Brothers was one of our biggest customers. We also developed machines to blow mold the

popular Igloo ice chests. I was very privileged to work with a leading blow molding development engineer, Don Peters of Phillips Petroleum's Bartlesville, Ok facility. Don was a prime developer of new technologies, including moving mold sections, die designs, die profiling and part designs that advanced large part blow molding and led to many new products. (The leading supplier of blow molding machines at that time was Kautex Machine of Germany. They had developed the accumulator die head which revolutionized large part blow molding. I also worked with Dennis Hunkar of Hunkar labs who developed the parison programmer for blow molding.)

During this period, I was sales manager of the Hartig Plastics group. One of my salesmen was a former Denver Broncos linebacker, Jeff Kuhman. Jeff was heavily involved in many of our projects and, along with Bob Slawska, led Hartig into many large part blow molding projects. Jeff later started his own business making extrusion and injecting molding screws. His company, Glycon, became a leading supplier of screws for the industry. Both he and Bob Slawska worked with Don Peters on many projects including the Igloo venture.

At Hartig I also worked with many pioneers in the plastic including Dr. Dwight Lohkamp of Exxon's principal polymer manufacturing facility in Bay Town, Texas. Dwight led Exxon into twin screw processing for their plastic resins. He was aided by another good colleague in the industry, Kurt Eise, of Werner Pfleiderer (now Coperion), a German twin screw manufacturer, who was a fellow Extrusion Division board member. Another board member of note was Bill Nissel of Welding Engineers Co., eventual owner of Welex. Welding Engineers made twin screw counter-rotating extruders used mainly for plastics and rubber compounding.

Some other engineers of note are Martin Batiuck of Goodyear's vinyl plastics division. Martin helped me and others in screw designs for PVC. Rick Knittel of Sterling Extruders and eventually Sano/Milacron became a recognized consultant in blown film systems.

The now-leading manufacturer of corrugated plastic drain pipe is Advanced Drainage Systems. The one man most responsible for their success was their leading engineer, Wayne Dunne. Wayne, who recently retired, was one of the first employees of ADS and led them into the prime position they now enjoy. Another member of the extrusion division was Bill McCormack of NRM one of their principal engineers who contributed to NRM's success as an extrusion systems machinery manufacture.

In 1972 I left Hartig to form my own company, Barr Polymer Systems. A large group of my fellow employees at Hartig joined me in this venture, including Jeff Kuhman, Bob Slawska, and John Hsu, our very accomplished chief engineer who obtained several patents for us in screw design and developed a new accumulator die design. This die design, the Hsu head, became the only accumulator head to compete with Kautex's. We managed to manufacture several large part blow molding machines such that we became a leading manufacturer of these machines. Although we were very successful in sales and engineering of these systems we were too financially limited to continue. Eventually we were bought out by Hoover Ball and Bearing Co.'s Uniloy division.

Their president, George Nichols, negotiated a tough deal whereby Uniloy took on all our debts and offered employment to many of us but none of Barr stockholders got any payment. We had no choice since we were almost bankrupt. Uniloy was the

pioneer and largest manufacturer of blow molding machines for milk bottles. They did not sell these machines. Rather they leased them to dairies, which was a novel and very successful approach. Uniloy assumed responsibility for the servicing and performance of these systems. The program was begun in the late-1950s, initiated and led by their marketing director, Sam Rupert. Also, instrumental in the design of the Uniloy blow molding systems was their Chief Engineer Bill Ziegler, who was the best machine designer I ever knew. I reported to the general manager, Fred Barhoff. Fred and I never got along well. He also left Uniloy some years later to start his own mold making business in New England.

Although I became the technical director at Uniloy I had been bitten by the bug to be my own boss. Jeff Kuhman, who also ended up at Uniloy, encouraged me to start my own business. He said I was so well known for screw design so that it would be a successful startup. He finally convinced me and I quit Uniloy and started Robert Barr, Inc. This was in 1976 and I was able to get permission from Uniloy to market the John Hsu barrier screw which was patented by Barr Polymer Systems but, in the buyout, became Uniloy's property. I did sell a few of these but soon was approached by Dr. Chan I. Chung, then at R.P.I, who had obtained a patent for a barrier screw that was an improvement to the original BARR screw. We worked out a deal in which he became a minority stock holder in Robert Barr, Inc. in exchange, he licensed his patent to our company which I marketed under the name of the BARR 2 screw. After a few years, he began to do the initial profile designs for me. Safe to say that our combination became very successful and the company is still very profitable. Dr. Chung wished to retire so we reached a buyout agreement and in 2004 I became sole owner of the company.

Thru all of this I continued as an SPE Extrusion Board member attending all of their meetings. In addition, my company has had a booth at every NPE from 1976 to the present.

One incident occurred when I visited Bill Miracle, Vice President of Cincinnati Milling machine, which had just started making injection molding machines. I met with Bill to convince him to use my barrier screws in his machines. He was very friendly and gave me a tour of the facility. However, he told me that they had no need for barrier screws. Bill was responsible for the great success of the then Cincinnati Milling Machine company, now Milacron. Still he just didn't see the need for advanced screw designs. Now Milacron is one of our valued licensees.

I was having my screws made by New Castle Industries in New Castle, Pa. Paul Colby was the general manager and very cooperative and helpful to our business. At that time, I also worked with their Chief Engineer, Jim Frankland, who eventually became New Castle's General Manager when Paul Colby left in 1978 to start Spirex, Inc. Spirex also became a leading supplier of screws and screw designs, competing with us. However, Paul remained a good friend. Another competitor, Tim Wormer, now a consultant for screw designs and a member of the Plastics Hall of Fame, has been a prominent competitor and a very active member of SPE, where he served as President in the 1990s.

Many have asked me why I hadn't set up the company to also manufacture screws. My experience at Barr Polymer Systems convinced me I was not a good manager. So I intentionally kept my second company as small as possible. For years, I did it all myself, but in 1978 I hired an office assistant Mary Gregor. She who helped me with typing, kept our company records and did all the purchasing as well as invoicing. In 1980, for personal reasons, I moved the company to Virginia Beach, Va. Mary Gregor did not want to move so I hired Lorraine Freeman to take her place. Lorraine Freeman remains a loyal and dedicated office manager in

our company.

The following years led to even greater success with only one set back, a big one! In 1983 we were sued by Uniroyal for patent infringement. This suit was instigated by Sterling Extruders and Davis Standard, both of which had a license from Uniloy on their barrier screw invented by Paul Geher. Paul's patent showed that the channel width of the solids channel in the barrier section was reduced to zero over that length while the melt channel width increased keeping the main flight lead constant. My patent showed a constant channel width keeping the barrier lead constant throughout the same as the main flight lead. A considerable difference.

The trial was a nightmare and we lost! Since we didn't have \$1 million I wanted to appeal. However, the cost to initiate an appeal was over \$200,000, which we didn't have either. I finally agreed to pay back royalties and to pay a royalty on new sales. The tab was over \$1 million! Owing to my loyal customers I was able to increase my prices and in six years paid off the entire amount. Our business continued to flourish. In 2000 I hired Jeff Myers, who was chief engineer at Glycon to help me. A few years later I promoted him to President and I became chairman. This continues with great success to this day.

Thru nomination by my good friend Don Peters of Phillips, in 2009 I was elected to the Plastics Academy Hall of Fame. A great honor to me which I really didn't think I was worthy of.

As I look back on my career, over 56 years in the plastics industry, I see that I was very fortunate to have been in on the beginning of the industry's growth and to have met and worked with many great talented people and associates thru all those years.

Now I am 86 but I continued to be involved and come up with new ideas for the company's products. As I look back I marvel at the incidents and associates I worked with for so many years. I did not realize until recently how important and pioneering our work was. All of the excellent people I met during those years were very instrumental in the progress of the plastics industry.

There is no question in my mind that I was very lucky! Sure, hard work and persistence are necessary but don't underestimate LUCK!

2017 ANTEC Extrusion Program

New this year at ANTEC ...Ask the Experts.

The Extrusion Division is introducing a new feature with this year's program. Ask the Experts is a series of sessions where you can get your production processing problems solved. One session is scheduled for Monday afternoon for film/sheet and profile extrusion, additional sessions are scheduled for Tuesday afternoon on single-screw extrusion, and another on twin-screw extrusion.

Each of these new sessions has an expert panel comprised of machinery manufacturers, consultants and academia that will provide different perspectives to answer your specific processing issues:

Monday, May 8: Ask the Expert Film/Sheet/Profile Extrusion Forum: Olivier Catherine (Cloeren), John Perdikoulis (Compuplast), Eldridge Mount III (EMMount Technologies), Mahesh Gupta (Plastic Flow).

Tuesday, May 9: Ask the Expert Single-Screw Extrusion Forum: John Christiano (Davis Standard), Allan Griff (consultant), Tim Womer (TW Womer & Associates), Kevin Slusarz (Slusarz Polymer Extrusion Consulting)

Tuesday, May 9: Ask the Expert Twin-Screw Extrusion Forum: Paul Andersen (Coperion), Robert Roden (Steer), Tom McHouell (Polymers Center of Excellence), Kenneth Russell (Optimized Polymers)

Each expert will give a short presentation to open the session, the remaining time will then be open to the audience for Q&A. You can justify coming to ANTEC this year to get REAL answers to your REAL problems!

We will still have presentations of submitted technical papers from Monday through Wednesday, and a tutorial session scheduled for Wednesday afternoon.

Here's the entire program:

Continued on next page

Monday AM				
Time	Session Title: Film Extrusion Moderator: Patrick Lee	Author	Session Title: Extrusion Science and Technology Moderator: Steve Schick	Author
8:00 AM	A Basic Experimental Study Of Cast Film Extrusion Process for Fabrication of Plastic Microlens Array Device	Chih-Yuan Chang, Yi.Min.Hsieh, Xuan-Hao Hsu	Keynote: "The Impact of Industrial Research in Polymer Processing: a Retrospective View"	Mark D. Wetzel
8:30 AM	Enhancement of Appearance, Stiffness, and Toughness of Olefinic Blown Films with Cyclic Olefin Copolymers	Paul D. Tatarika		
9:00 AM	Using Coextrusion Layer Splitting to Improve Film Tear Strength	Iyad Muslet	Investigation Of The Effect Of Filler Concentration On The Flow Characteristics Of Filled Polyethylene Melts	Gregory A. Campbell, Mark D. Wetzel, John C. Howe, Michael T. Sterling
9:30 AM	Orienting Melt to Produce On Lab-microscale High Performance and Ultra Thin Foils	Han E.H. Meijer, Lou Nijsten, Martin Quaedflieg	The Rheology Of Concentrated Slurries: Experimental Evaluation And The Effects On Polymer Processing	Mark D. Wetzel, John C. Howe, Michael T. Sterling, Gregory A. Campbell
10:00 AM	Study of Residence Time Distribution for a Blown Film Line Using Inline Uv-vis Spectroscopy and Optical Imaging on a Film Bubble	Jin Wang, Christopher Thurber, Michael Bishop, Daria Monaenkova, Eric Marchbanks, Hyunwoo Kim, Ellen Keene, Xiaoyun Chen	Micropelletization Of Virgin And Recycled Thermoplastic Materials	Christian Schafer, Jackson S. Bryant, Tim A. Osswald, Stefan P. Meyer
10:30 AM	On The Role Of Extensional Rheology, Elasticity And Deborah Number On Neck-in Phenomenon During Flat Film Production	Martin Zatloukal, Tomas Barbarik, Costas Tzoganakis	Thermoplastic Polyurethane Foaming Through Extrusion Using a Blowing Agent	Qingping Guo, Andrew Kenny, Shahid Ahmed, Ghaus Rizvi
11:00 AM	Interfacial Crystallization Affects Adhesion Of Coextruded Polyolefins	Alex M. Jordan, Kyungtae Kim, Frank S. Bates, Christopher W. Macosko, Shaffiq Jaffer, Olivier Lhost	Rheology Of Acrylonitrile Butadiene Styrene With Hollow Glass Microspheres For Extrusion Process	Peng Liu, John Lindahl, Ahmed Arabi Hassen, Vlastimil Kunc
Monday PM				
Time	Session Title: Ask The Experts - Film/sheet/profile Extrusion Forum Moderator: Karen Xiao	Author	Session Title: Multi-Screw Extrusion Moderator: TBA	Author
	Expert Panel: John Perdicoulis/Mahesh Gupta/Olivier Catherine/Eldridge M. Mount III		Keynote: "Control of Morphology Developments in Polymer Blending Using Reactive Extrusion Technology"	Dr. Tadamoto Sakai
2:00 PM	A Short Overview of Coextrusion Technology for Sheet, Flat Film and Extrusion Coating Applications	Olivier Catherine		
2:30 PM	Optimization of Extrusion Dies for a Uniform Exit Velocity Distribution	Mahesh Gupta		
3:00 PM	Shear Stress vs Shear Rate as Flow Channel Design Criteria	John Perdikoulis	Direct Extrusion of PVC on the Planetary Roller Extruder	Dr. -Ing. Thomas Birr, Michael Batten
3:30 PM	Emerging Barrier Coextrusion Technology for Oriented Polypropylene Films	Eldridge M. Mount III	Effect of Screw Speed on Polyethylene-Calcium Carbonate Composites Produced Using Twin and Quad Screw Extruders	Eldridge M. Mount III
4:00 PM	Q&A from audience			
Tuesday AM				
Time	Session Title: Twin-Screw Extrusion Moderator: David Bigio	Author	Session Title: Single-Screw Extrusion Moderator: Mahesh Gupta	Author
8:00 AM	Fill Ratio Distribution in a Co-rotating Self-wiping Twin Screw Extruder: Theoretical and Experimental Study	Kentaro Taki, Shin-ichiro Tanifuji, Takemasa Sugiyama, Jun-ichi Murata, Isao Tsujimura	Virtual and Experimental Comparison of Different Dynamic Mixing Devices for Single Screw Extrusion	Bastian Neubrech, Gregor Karrenberg, Johannes Wortberg
8:30 AM	Fundamentals of Twin-screw Compounding: Kneading Block Performance Characteristics	Paul G. Anderson	Scaling Laws and Fractal Screw Designs Towards Single Pellet Extrusion	D.O. Kazmer
9:00 AM	Effect of Ethylene Content on Maleic Anhydride-grafted Polypropylene Based Block Copolymers	Wenyi Huang, Parvinder Walia, Yushan Hu, Zhe Zhou, Nicholas Horstman, Tianzi Huang	Analyzing the Viscous Dissipation of a Two-dimensional Flow of Non-newtonian Fluids in Single Screw Extruders	Wolfgang Roland, Jurgen Miethlinger
9:30 AM	Developing a Soft Sensor Random Forest Model for the Inline Product Characterization of Polylactide (PlA) in a Twin Screw Melt Extrusion Process	Konrad Mulrennan, Marion McAfee, John Donovan, Leo Creedon	Mitigating Gels in Polyethylene Products Produced Using Grooved-bore, Single-screw Extruders	Mark A. Spalding, Timothy W. Womer
10:00 AM	High Speed Twin Screw Extrusion for Biodegradable Polymer Blends: Analysis of Compatibility and Rheology Prediction	Barbara A. Calderon, Margaret J. Sobkowitz		
10:30 AM	Enhanced Dispersion of Particle Additive Into Polymers Using Twin Screw Extrusion With Ultrasound Assistance	Karnik Tarverdi, Kun Qj, Jack Silver		
11:00 AM	Mechanism of the Operating Conditions on Dispersive Mixing and Humidity of Polymer in a Twin Screw Extrusion Process	Masuma Khatoun Ema, Ben Dryer, Nitish Balakrishnan, David I. Bigio, Chad Brown, Francis Flanagan, Fengyuan Yang		

Continued on next page

Tuesday PM				
Time	Session Title: Ask The Experts: Twin-Screw Extrusion Forum Moderator: Adam Dreiblatt Expert Panel: Robert Roden/Paul Andersen/Tom McHouell/Ken Russell	Author	Session Title: Ask The Experts: Single-Screw Extrusion Forum Moderator: Mark Spalding Expert Panel: Tim Womer/John Christiano/Allan Griff/Kevin Slusarz	Author
2:00 PM	Scale up: The Bump in the Road between Development and Commercialization	Paul Anderson	What Causes Catastrophic Failures to Extrusion Screws	Tim W. Womer
2:20 PM	Reactive Extrusion with Selective Condensation	Kenneth Russell	Selecting the Optimum Extruder and Screw Design for Your Application	John P. Christiano
2:40 PM	Safety Consideration in Compounding	Tom McHouell	A Fundamental Review of Screw Design for a Single Screw Extruder	Kevin Slusarz
3:00 PM	Process Design for the Side Feeding of Sensitive Fillers and Additives	Robert Roden	10 Key Principles of Extrusion	Allan Griff
3:30 PM	Q&A from audience			
Extrusion Division Awards Ceremony and Reception				
Wednesday AM				
Time	Session Title: Simulation & Modeling Moderator: TBA	Author		
8:00 AM	Elastomer Profile Coextrusion Simulation for Automotive Sealing System	Linhuo Shi, Shihamul Islam, Mahesh Gupta		
8:30 AM	Simulative Evaluation of the Temperature Influence on Different Types of Pre-distributors in Spiral Mandrel Dies	Christian Hopmann, Nafi Yesildag		
9:00 AM	The 3D Viscoelastic Simulation of Multi-layer Flow Inside Film and Sheet Extrusion Dies	Kazuya Yokomizo, Makato Iwamura, Hideki Tomiyama		
9:30 AM	Modeling Three-Dimensional Non-Newtonian Flows in Single-Screw Extruders	Christian Marschik, Wolfgang Roland, Bernhard Low-Baselli, Jurgen Miethlinger		
10:00 AM	Validation of Residence Stress Distribution Approach Using 1-d Computer Simulations	Nitish Balakrishnan, Ben Dryer, David Bigio		
10:30 AM	Design Optimization of Maddock Mixers for Single-screw Extrusion Using Numerical Simulation	Xiaofei Sun, Mark A. Spalding, Tim W. Womer, Ned Uzelac		
Wednesday PM				
Time	Moderator: TBA Session Title: Extrusion Tutorials	Author		
2:00	Extrusion: From the Polymer's Point of View	John Perdikoulis		
2:30	How To Read A Material Data Sheet	Allan Griff		
3:00	Melt Temperature Measurement in Compounding	Kenneth Russell		
3:30	Challenges for Extrusion Technology in a Pharmaceutical GMP Environment	Chad Brown		
4:00	High Performance Devolatilization for Twin-Screw Extruders	Robert Roden		

Technical Tip

Optimize Feeding to Make More Money in Twin-Screw Compounding

Follow these practical examples to improve the feeding efficiency and productivity of your process.

By Alex Utracki
Coperion Corp.

Every business wants to increase profits. Companies can deploy many strategies to do so that can fall across various areas of the business, such as reducing inventory, negotiating lower prices from suppliers, or increasing marketing efforts, to name a few.

When it comes to operations, the capital equipment is often already in place and is therefore a sunk cost. Increasing profitability in this case usually depends on maximizing productivity of these assets. For twin-screw extrusion processes, this is most easily achieved by increasing throughput rate, thereby spreading operating costs (depreciation, labor, maintenance, etc.) over a greater amount of product produced in the same unit of time. Another option to reduce cost is by increasing energy efficiency in converting raw materials into finished goods. Since energy is relatively inexpensive in the U.S., the dollar amount of these savings tends to be minor compared with productivity increases. But there are other benefits businesses can realize by cutting energy consumption, such as reducing their carbon footprint and enhancing public image. In some cases, though, it is possible to achieve both increased productivity and reduced specific energy consumption.

When it comes to increasing throughput, first find out what is causing the current limitations. For twin-screw extrusion processes, limitations can exist anywhere from the feed system through the process section to the downstream equipment. For example, difficult-to-handle materials may stick or flow poorly through feeding equipment, limiting the rate at which they can be discharged into the twin-screw extruder. In the process section, an improperly designed melting section may not be able to fully melt the polymer above a certain throughput rate.

Conversely, materials with a high energy requirement to melt may be limited in rate by the amount of power that the motor and gearbox combination is able to supply. Limitations in the downstream equipment include high discharge pressure in the case of high-viscosity materials and restrictive dies, and high pellet temperature in the case of inadequately sized cooling equipment. Only once the limitation is understood can steps be taken to remove it. This process is one of continuous improvement, where if one limitation is removed, another will be uncovered at a higher throughput rate.

Click [here](#) to read this article in full on the Plastics Technology website.

Technical Tip

Do You Have Screw Wear?

It's generally caused by metal-to-metal contact, and your first indicator will be poor melt quality.

***By Jim Frankland,
Frankland Plastics Consulting, LLC***

Unless you are running abrasive fillers, screw wear is generally the result of metal-to-metal contact between the barrel liner and the screw flights. Wear can be quite slow or very rapid, depending on the contact force between the screw flight and the barrel liner and the lubricating effect of the polymer.

With proper screw/barrel alignment and a filled screw, wear typically occurs mostly in the melting or compression section of the screw. In the compression section, the polymer is forced through a smaller and smaller area; as it moves through that section the melt is often being compressed 2-5:1. If all the melt gets squeezed out, the channel will momentarily be filled with solids. Since a tapered-root screw is really a powerful compounded spiral wedge, it can develop enormous pressure when filled with incompressible solids. That's the case regardless of whether it's a conventional or barrier-type screw.

When the channel becomes filled entirely with solids and plugging occurs, there is a high radial or unbalanced side pressure on the screw. This pushes or deflects the screw, sometimes with tremendous force, against the opposite side of the barrel wall, forcing out the lubricating film of polymer. As a result, the surfaces are then rubbing metal-to-metal while under high load with little or no lubricating polymer film between the screw flights and the barrel liner. The loading force and the characteristics of the materials selected for the screw-flight hard facing and the barrel liner then determine the wear rate. The type of polymer also has an effect; crystalline polymers develop much higher plugging forces than amorphous polymers and hence generally higher wear issues.

How do you know this is happening? Your output may not be significantly affected until the screw/barrel clearance becomes fairly large. Most likely, the first thing you'll notice is a loss of melting rate as evidenced by a gradual decrease in the melt quality. Using the classic melting model that fits most polymers, the melt film forms primarily from shearing the solids against the barrel wall, thereby changing mechanical energy (screw rotation) into thermal energy (melting).

Click [here](#) to read this article in full on the Plastics Technology website.

Wetzel to Receive Research/Engineering Technology Award



At next week's ANTEC, SPE will award Mark Wetzel will be given SPE's Research/Engineering Technology Award.

Wetzel provided technical leadership for the DuPont in the area of polymer process development, scale-up and analysis before his retirement in 2016. He has over 37 years of experience in various areas that include fundamentals of extrusion and compounding, extrusion and compounding process development, new product development through process innovation, and polymer nanocomposites and the safe handling of nanomaterials.

Since 1995, Mark has collaborated with many leading academics and practitioners in the polymer processing field with over 45 publications on extrusion process characterization, melting fundamentals, residence time distribution, polymer nanocomposites and process control. Mark is an active member of the Society of Plastics Engineers and its Extrusion Division. Mark was elected an SPE Fellow in 2008 and served as the Extrusion Division chair in 2010. Mark is now the Councilor for the Extrusion Division.

This award is sponsored by the SPE Extrusion Division.

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