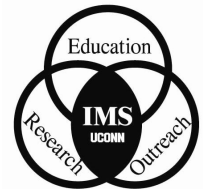




# University of Connecticut Institute of Materials Science



## IMS Associates Program Newsletter

Vol. 4, No. 1

January 18, 2000

### Norton Company Gift

The fund raising effort underway at IMS (see IMS Expansion on page 4) is continuing. Our thanks this issue to the Norton Company Foundation for their recent \$10,000 gift to IMS. The Norton Company has had a long history of col-

laboration with the University of Connecticut, in particular IMS, and has been a member of the Associates Program since 1981. Thanks again to Norton for their continued support of IMS.

### Montgomery Shaw wins Distinguished Professorship Award

Montgomery Shaw, Professor of Chemical Engineering at the University of Connecticut, has won one of three Distinguished Professorship Awards. The award is presented to full tenured professors who demonstrate sustained research leadership and a commitment to widespread disclosure of research findings. The awardees receive a \$10,000 annual professional development grant for a period of three years.

The other two awards were presented to Ted Bergman, Professor and Department Head of Mechanical Engineering and Peter Luh, Professor of Electrical and Systems Engineering and Director of the Booth Research Center. Text of the complete announcement can be found at <http://www.engr.uconn.edu/SoE/frontiers.pdf>.

### Honorary Doctorate of Philosophy Awarded to Anthony T. DiBenedetto

On November 11, 1999 the largest University of Technology in the Czech Republic, Brno University of Technology, celebrated 100 years with the School of Chemistry celebrating 150 years. On this occasion, five honorary doctorates of philosophy, Dr. h. c. (Doctor honoris causa) have been awarded to leading scientists in chemical

engineering, architecture, mathematics, metallurgy and mechanical engineering. The two chemical engineering Dr. h. c. were awarded to Professor Anthony T. DiBenedetto of UCONN and Professor Phillip Geil of University of Illinois in Champaign for their huge contributions to the field of polymer composites and polymer morphology, respectively.

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Royal Interior Architect, Ms. Jiricna of UK was awarded Dr. h. c. for her contribution to the field of interior architecture, Professor Vitek of Penn State for his work in metallurgy and Professor Kurzweil for his work in theory of solving differential equations.

The ceremony took place in University Center which opened just two days before the ceremony. The Center is located in a newly renovated 40,000 sq.ft. monastery founded in 16th Century. Presidents of the 14 largest Czech Universities, including the Charles University in Prague established in 1349, attended the ceremony. The Deputy Minister of Education, Youth and Sports also attended. The whole ceremony was conducted in Latin. The introduction, *laudatio*, of Professor DiBenedetto was wel-

comed with great applause and was shown on the main evening news on the two largest Czech TV stations, CZ TV and TV NOVA.

The inaugural lecture of Professor DiBenedetto on interface engineering in fibrous composites at the Auditorium of the School of Chemistry was attended by 250 faculty, students and guests from industrial R&D. The recognition of Professor DiBenedetto is not only for his personal contribution to the science and engineering of fibrous composites but also an expression of appreciation of the growing research and educational collaboration between the University of Connecticut's Institute of Materials Science and the School of Chemistry Brno University of Technology.

## New IMS Faculty

Dr. Marcel Utz, Ph.D. Materials Science, ETH Zurich, will join the Polymer Program in the Spring of 2000. His research interests include solid-state NMR spectroscopy of polymers, plastic deformation of polymer

glasses and other amorphous materials, atomistic computer modeling, statistical mechanics of glasses and supercooled liquids.

## Current Topics in Adhesion Science and Composites

Plans are currently being finalized for a special symposium dedicated to Jim Bell, Professor of Chemical Engineering at the University of Connecticut, to honor his 65th birthday. The symposium will be held on Monday, May 22, 2000 at the Institute of Materials Science on the Storrs campus of the University of Connecticut.

The speakers include Moshe Narkis (Technion, Israel), Guy Davis (DACCOSCI), Tony DiBenedetto

(UConn), Ray Dickie (Ford), Larry Drzal (Michigan State Univ), Jim Wightman (Virginia Tech), Sam Huang (UConn), Jude Iroh (Univ. Cincinnati), Hee-Woo Rhee (SoGang Univ, Korea), Randy Schmidt (Dow Corning), Jeng-Li Liang (International Imaging Materials) and Rajat Agarwal (Henkel Surface Tech.). The talks will cover areas of research that Jim has been involved with, e.g., composites, adhesion, electropolymerization, and the S-Poly process. Watch your mail for further details.

## Symposium on Biorelated Materials

Samuel Huang, Professor of Chemistry at the University of Connecticut, and Emo Chiellini of the University of Pisa, are co-chairs of a Symposium on Biorelated Materials as part of Poly Millennium 2000 to be held in Hawaii, December 9-13, 2000. See the an-

nouncement on page 7. The conference will be held one week prior to Pacifichem 2000 in order to allow polymer scientists to participate in two international meetings upon making the trip to Hawaii.

## Seminars

The Polymer Program seminar schedule for the spring of 2000 is on page 8. Other seminar schedules have not been finalized at this time. This information will be available on the World Wide Web at <http://www.ims.uconn.edu/>. We will forward other seminar schedules as they become available. Abstracts of seminars are usually available about a week

in advance. Let us know if you would like to receive any abstracts to help you decide about attending. We can also put you in touch with the faculty member sponsoring the seminar to learn more about the specific seminar of interest. We also suggest you call before attending to be sure there have not been any last minute changes.

## New Equipment

IMS has recently acquired three new instruments that greatly expand the capabilities of the rheology laboratory. Included are an Advanced Rheometric Expansion System from Rheometric Scientific, a Paar Physica UDS 200 Universal Dynamic Spectrometer, and a TA Instruments DMA 2980 Dynamic Mechanical Analyzer. All of these instruments are Windows compatible for ease of use and are upgradeable.

The Advanced Rheometric Expansion System, or ARES, is a modular controlled strain rheometer, which can be configured to test thermoplastics, thermosets, elastomers and fluids. Measured viscoelastic properties are steady shear viscosity, normal force, shear modulus, complex viscosity, storage modulus, loss modulus and damping. A variety of fixtures are available for different test geometries. Besides the standard steady/dynamic actuator, the ARES can also be used with a high resolution, low dynamic strain actuator for characterizing structured fluids, or an air-bearing actuator designed for low shear and normal force measurements. Three environmental systems expand the ARES versatility. An air-convection oven has a range of -150C to 600C for testing polymer melts and solids. A fluid bath is available for liquid samples otherwise susceptible to evaporation. Finally, a Peltier system can provide rapid temperature changes from -30C to 150C.

The Physica UDS 200 is a high-performance controlled stress rheometer useful for structural analysis of low-viscosity substances. It will perform rotational

and oscillatory tests with controlled shear rate or shear stress at temperatures from -180C to 600C with cylinder, cone/plate or plate/plate geometries. A special clamp may be used for testing solids. Other functions available are creep, normal force, electro-rheological, stress-relaxation, free oscillation, and superimposed flow or multiwave tests. Wide torque and frequency ranges allow for realistic determination of viscoelastic behavior in order best to predict processability and lifetime of materials.

TA's DMA 2980 measures physical properties of elastomers, thermoplastics, viscous thermosetting liquids, composites, coatings, adhesives, ceramics and metals, as influenced by time, frequency and temperature effects in response to periodic stress. The DMA 2980 provides information on modulus, damping, glass transition and softening temperatures, rate and degree of cure, viscosity, onset of gelation, sound absorption, impact resistance, creep, and stress relaxation. Samples from 5-micron films to 30mm fibers can be evaluated. An optical encoder measures displacement at a much higher resolution than a traditional LVDT. The frequency range covers four decades and test temperatures from -150C to 600C can be accommodated. Testing modes include 3-point bend, single- and dual-cantilever, shear sandwich, tension and compression. The DMA 2980 can also double as a thermomechanical analyzer, measuring thermal expansion and contraction of materials under a constant load.

## New Members

Six companies joined the Associates Program during 1999:

Anocoil Corporation, Rockville, CT  
Arch Chemical, Cheshire, CT  
Dexter Corporation, Windsor Locks, CT  
Loctite Corporation, Rocky Hill, CT

New Era Materials, Pawcatuck, CT  
Spellman High Voltage Electronics, Hauppauge, NY

We welcome our new members and look forward to working with them. There are presently 33 members of the Program.

## IMS Expansion

The present building for the IMS was completed in the early 1970s. Since that time our growth has led to building rooms in the halls, converting three of the four seminar/class rooms into offices or laboratories, and serious overcrowding in the laboratories. IMS is very pleased that support from UConn 2000 has been made available for construction of a 15,000 sq. ft. addition to be located on the plaza. Planning for this expansion is in the final stages. Construction should begin shortly.

Funds are badly needed to equip this new space and to upgrade outdated laboratory equipment in our existing space. This is truly a "once in 30 years" opportunity. Approximately \$5M is needed. The new building and associated update of research equipment at IMS will be very important in projects that are of interest to IMS Associates Program member companies. Examples include state-of-the-art transmission electron microscopy, small spot x-ray photoelectron spectroscopy and time of flight SIMS facilities. Each of these equipment groupings costs in excess of \$500,000. Several items will be available only at

UConn in this region. As with all IMS facilities, they will be available to all Associates Program member companies.

We respectfully request that member companies and friends consider, as partners and close collaborators, a one-time gift for the re-equipping of the Institute. This new equipment will help IMS, which already has an excellent reputation, step forward as a national leader.

In our 30 year history IMS has not made such an appeal. This is truly a special time when we need to advance our mutual interests through this equipment and facilities.

For further information please contact:  
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## Cluster Power

The Connecticut Department of Economic and Community Development (DECD) has opted to use an industry cluster system for aiding strategic and tactical planning of economic development in Connecticut. The cluster concept utilizes the notion that a group of companies in a given industry or complex have certain mutual problems which, if defined, can be addressed more broadly for the industry rather

than deal less effectively with the individual companies.

Connecticut DECD in concert with several ad hoc industrial and commercial committees has identified six industry clusters - Tourism, Financial Services, Manufacturing, High Technology, Telecommunications and Healthcare Services - that are being given

focused attention in the coming months and years to address their concerns. The modus operandi has been to identify a host for each cluster, and for DECD to help in the early stages of administration and planning.

There is an effort underway to explore the value of a materials subcluster under a manufacturing or advanced technology cluster. The time is right for getting attention drawn to materials problems, issues, etc., in Connecticut through the cluster concept if enough common avenues can be found to link people and companies to qualify as a cluster. The Connecticut DECD has championed the cluster concept for state economic development.

## Short Courses

The IMS Associates Program is planning to offer three short courses (12-16 contact hours) over the next year. The courses are Polymer Analysis and Characterization; Introduction to the Design of Experiments; and Response Surface Methodology. We are considering offering the courses on the UConn Storrs campus in a traditional classroom environment or by Real Time Interactive Compressed Video at the various UConn campuses (if there is enough interest and compatible equipment, the course could also be broadcast directly to your site). Exact time is still to be determined depending on interest level and preferences of the majority regarding ICV versus presentation at the Storrs campus.

## Short Course Registrations

In the past a small number of people have registered for short courses through the Associates Program and not attended. The Associates Program must still pay full price in this situation. Please note that participant substitutions can be made at any time and

## SPE Plastics Short Courses

The Society of Plastics Engineers has scheduled plastics short courses in Rhode Island in March 2000.

The first workshop was held on Wednesday, June 16, 1999 at the Institute of Materials Science. Subcommittee meetings have been held to identify the potential approaches to be addressed by the Advanced Materials Cluster. A second workshop is planned for early in 2000 to define the initial goals and objectives of the cluster that have been discussed by the subcommittees. For additional information please contact Jack Crane, CONN/STEP, (203) 786-5481, (860) 786-5037 (fax), [jcrane@connstep.org](mailto:jcrane@connstep.org) or Dr. Harris L. Marcus, IMS, UConn, (860) 486-4623, (860) 486-4745 (fax), [hmarcus@mail.ims.uconn.edu](mailto:hmarcus@mail.ims.uconn.edu).

Cost per registrant will probably be about \$400 and Associates Program members will receive one free registration.

Many of you have received a preliminary description of these courses in your email. If you have not responded I would greatly appreciate your input. Preliminary course descriptions and instructor biographies are on page 9.

Plans will be finalized during the spring semester and announcements will be mailed at that time.

registration can usually be canceled at minimal cost until the day before the course. We understand that occasionally plans must change but request your assistance when such changes occur.

Please see page 12 for titles and dates.

## Spring Semester Starts

Spring semester 2000 classes start January 26, 2000. Some courses that may be of interest include the following.

CHEG-256	Polymeric Materials (Intro)	P. Mather
CHEG-367	Polymer Rheology	P. Mather and M. Shaw
CHEG-352	Polymer Properties	J. Bell
CHEM-384	Polymer Characterization II	C. Sung
CHEM-387	Polymers Reactions	F. Papadimitrakopoulos
MMAT-316	Metallurgy and Mechanics of Fracture	L. Shaw

MMAT-323	Electron Microscopy	M. Aindow
MMAT-320	Physical Ceramics	T. Kattamis
MMAT-343	Corrosion	N. Greene
MCB-313	Structure and Function of Biological Macromolecules	J. Knox

CHEG-256 is an undergraduate course. All of the others are graduate courses. Some courses require pre-approval of the instructor. For further information please call Ed Kurz.

## Associates Program Annual Meeting

The Associates Program Annual Meeting has been scheduled for Tuesday, June 6, 2000. Watch your mail

for further details.

## Publications of Interest

Over the years Dr. Ezrin, Director of the Associates Program, has published numerous articles which are of interest to those in various industries utilizing

polymers. A selected listing is on pages 10 and 11. Reprints are available from Dr. Ezrin.

## Sample Preparation

In many projects that the Associates Program deals with, such as adhesion and coatings, surface analysis techniques are extremely important. The techniques used for such analysis, particularly GC/MS, Auger electron spectroscopy (AES) and x-ray photoelectron spectroscopy (XPS) are extremely sensitive to small amounts of material on the surface. It is important to make efforts not to contaminate these surfaces during sample preparation, collection and shipment. **Shipment in common plastic bags should be avoided!** Common plastic bags typically contain significant amounts of additives used to prevent the plastics from adhering to themselves and other materials. These additives will migrate to the sample during shipment and at best make interpreta-

tion difficult and sometimes impossible. It is much better to ship such samples in common kitchen aluminum foil (not industrial aluminum foil which is often also coated with an oil or other release agent). Samples could also be shipped in glass containers with aluminum foil over the opening under the cap.

Alternatively special polyester bags which do not contain such additives can be purchased. One source of such bags is the Kapak Corporation, 5305 Parkdale Drive, Minneapolis, MN 55416, 612/541-0730. Typical price is about \$200 per thousand depending on the exact size. Be sure to specify non-contaminating/non-plasticized material.

**POLY MILLENNIAL 2000**  
An International Conference

Including Biennial Events Sponsored by  
The Division of Polymer Chemistry  
American Chemical Society

**Hilton Waikoloa Village**  
**Waikoloa, Hawaii**  
**December 9-13, 2000**

**Symposium on Biorelated Materials**

- Biocompatibility and biodegradation
  - Polymers from renewable resources
  - Biomedical & pharmaceutical applications
  - Consumer and commodity applications
  - Ecological aspects and waste management
- ◆ Oral and poster presentations

**Co-Chairs:** Samuel J. Huang and Emo Chiellini

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## POLYMER SCIENCE SEMINARS Spring Semester 2000

- January 28**                    **Amphiphilic Approaches to New Materials Synthesis with Controlled Organization**  
*Prof. Coleen Pugh, University of Akron*
- February 4**                    **DC Conduction in Polyethylene and Related Polyolefins**  
*Prof. Dwight Damon, University of Connecticut*
- February 11**                    **Switchable Diffractive Elements via Holographic Polymer-Dispersed Liquid Crystals**  
*Dr. Timothy Bunning, Wright Patterson Air Force Research Lab*
- February 25**                    **Palladium-Catalyzed Routes to Arylamine Macromolecules**  
*Prof. John F. Hartwig, Yale University*
- March 3**                        **Tailoring the Molecular, Morphological, and Microstructural Characteristics in Polymeric Materials for Optimum Energy-Absorbing Characteristics**  
*Prof. Alan J. Lesser, University of Massachusetts at Amherst*
- March 10**                        **A Fracture Mechanics Approach to Environmental Stress Cracking in Poly (ethylene terephthalate)**  
*Dr. Eric Moskala, Eastman Chemical Company*
- March 24**                        **Synthesis of Novel Biodegradable Polymers**  
*Prof. Ann-Christine Albertsson, Royal Institute of Technology, Stockholm*
- April 7**                         **Producing Microporous Polymeric Films by a Melt Process and their Associated Structural Studies**  
*Prof. Garth L. Wilkes, Virginia Polytechnic Institute*
- April 14**                        **Heart Attacks and Hydrogels**  
*Dr. Ronald A. Sahatjian, Boston Scientific Corporation*
- April 28**                        **Structure and Dynamics of Polymers in the Presence of Fillers**  
*Dr. Alan I. Nakatani, National Institute of Standards & Technology*
- May 22**  
(Monday)                        **Current Topics in Adhesion Science and Composites**  
A One Day Symposium

All seminars are on Fridays at 11:00 AM in IMS Room 20.

Coffee will be served at 10:30 AM outside the seminar room.

For more information, please contact Y.H. Chudy at (860) 486-3582; Fax (860) 486-4745; E-mail [yhchudy@mail.ims.uconn.edu](mailto:yhchudy@mail.ims.uconn.edu) or visit [www.ims.uconn.edu](http://www.ims.uconn.edu) on the Web.

*This seminar series is sponsored in part by the Bayer Foundation.*

## Short Courses

### Introduction to the Design of Experiments (DOE Course #1)

This course will start with Screening Designs, that is, designs which determine which parameters or factors have an effect on the outcome of a process. Based on such designs we will see how to analyze the results both analytically and graphically. Orthogonal Arrays (Taguchi) and Plackett-Burman designs will be introduced. Factorial designs which allow the determination of the effect of important parameters and their interaction with each other will be considered. When there are a number of different parameters, Fractional Factorial designs along with their resolution are studied because they can be more efficient. It is extremely important to look at sources of variation and blocking. We will also consider using experiments sequentially so that prior experiments can be easily combined with current results. Throughout the course Taguchi methods and philosophy will be discussed. Finally, sample size and power calculation will be introduced. These give the engineer insight into whether or not a proposed experiment is worthwhile.

### Response Surface Methodology (DOE Course #2)

After having found out which parameters or factors are important to a process, it is still necessary to determine their optimal settings. To attack this problem, we will begin with fractional factorial designs and then move to Rotatable designs. These designs give equal information in all directions on the surface. To minimize the number of experimental runs, blocking and sequential designs will be considered. Designs that answer questions, such as, are more experiments necessary, in which direction is the optimum, are we near the optimum, and what does the response surface look like will be introduced. Questions of stability of response based on Taguchi philosophy are also studied. For processes already in use, we will look at the method of Evolutionary Operation which encourages continuous improvement.

#### Brief Instructor Biography

Uwe Koehn received his Ph.D. in Statistics from the U. of Illinois at Champaign-Urbana. He was Head of the Department of Statistics at the University of Connecticut for 12 years and directed the department's statistical consulting service for more than 25 years. Having taken emeritus status, he is devoting his time to statistical consulting and research. He has consulted with and taught short courses to more than 30 companies and organizations, as well as having worked with numerous engineers and scientists within the University.

### Polymer Analysis and Characterization

This course will cover the basics in polymer analysis and characterization from molecular properties such as radius, molecular weight and chemical composition to materials characteristics such as glass transition temperature, melt viscosity and modulus. The integration of the molecular picture with an understanding of materials concepts will enable the plastics chemist or engineer to understand and utilize correlations between structure, product design and analysis of competitive products.

Synthetic fundamentals will be discussed briefly to provide a context for the scope of available structures that polymers comprise. Compositional analysis of polymers using spectroscopic techniques (NMR, IR, GC/MS) will follow. Fundamentals of light scattering, osmometry, viscometry, and GPC will be discussed as methods of measuring molecular weight distribution. Materials characterization by thermal analysis (DSC, TGA, etc.) and rheological techniques as well as special methods for probing surface properties (XPS, TEM and scanning probe microscopy) will complete the curriculum.

This course is aimed at scientists and engineers who are currently working with polymeric materials and wish to extend their knowledge of polymeric materials so as to achieve the best possible processing and performance of their products.

#### Brief Instructor Biography

Thomas A. P. Seery is an Assistant Professor of Chemistry in the Polymer Program at UConn. He received his Ph.D. in Chemistry from the U. of Southern California where his research focused on static and dynamic light scattering studies of macromolecular solutions and investigations of polymer-polymer and polymer-solvent interactions. He was a Postdoctoral Research Fellow at the U. of California, Berkeley and Lawrence Berkeley Labs where he conducted research in aqueous synthesis of highly conjugated polymers using organometallic catalysts and characterization of rigid backbone polymers using light scattering and transient electric birefringence. His current research interests include synthesis of polymer on surfaces using tethered initiators; polyelectrolyte solutions; associating polymer systems; Light scattering studies of absorbing systems. He is Associate Editor of *Polymer Engineering and Science*. He received the 3M Nontenured Faculty Award in 1998 and the NSF CAREER Program Award in 1999.

**Selected Publications of Myer Ezrin  
Director of the IMS Associates Program  
Fellow of the Society of Plastics Engineers**

**PLASTICS FAILURE ANALYSIS**

1. Ezrin, M. and J. Harten. 1981. Thermogravimetric analysis screening of flame retardant thermoplastics for molding safety, Soc. Plast. Eng. ANTEC, 188-189, Boston.
2. Ezrin, M. and J. Gartner. 1984. Test method for evaluation of the resistance of fiberglass rods to combined mechanical and chemical stress, IEEE Transactions on Power Apparatus and Systems, Vol. PAS-103, No. 9, 2741-2745.
3. Ezrin, M. 1988. Materials factors in plastics failure, Soc. Plast. Eng. ANTEC, 1492-1494, Atlanta.
4. Ezrin, M. and J.H. Groeger, Jr. 1989. Examination of field failures of fiberglass rod guy strain insulators, Soc. Plast. Eng. ANTEC, 1603-1606, New York.
5. Ezrin, M. 1989. Gallery of goofs -#20, Plastics Design Forum, Sept./Oct., 53-56.
6. Ezrin, M. 1990. Case studies of low cost PE, PS and PVC products, Soc. Plast. Eng. ANTEC, 1478-1482, Dallas.
7. Ezrin, M. 1991. Case studies of failures due to unintentional service conditions, Soc. Plast. Eng. ANTEC, 2213-2216, Montreal.
8. Ezrin, M. and G. Lavigne. 1991. Failure analysis using gas chromatography/mass spectroscopy, Soc. Plast. Eng. ANTEC, 2230-2233, Montreal.
9. Ezrin, M. and G. Lavigne. 1992. Application of direct dynamic headspace GC/MS to plastics compositional and failure analysis, Soc. Plast. Eng. ANTEC, 1717-1719, Detroit.
10. Ezrin, M. 1992. Gallery of goofs -#23, Plastics Design Forum, Sept./Oct., 29-32.
11. Ezrin, M. and G. Lavigne. 1994. Failures caused by additives and contaminants during processing and storage, Soc. Plast. Eng. ANTEC, 3302-3305, San Francisco, CA.
12. Ezrin, M. and G. Lavigne. 1995. Case studies of adhesive failure of bonded plastics, Soc. Plast. Eng. ANTEC, 3936-3940, Boston, MA.
13. Ezrin, M., G. Lavigne, P. Klemchuk, W. Holley, S. Agro, J. Galica, L. Thomas and R. Yorgensen. 1995. Discoloration of EVA encapsulant in photovoltaic cells, Soc. Plast. Eng. ANTEC, 3957-3960, Boston, MA.
14. Ezrin, M., G. Lavigne, P. Klemchuk, J. Pickering, W. Holley, J. Galica, S. Agro, W. Nelson and Q. Wu. 1996. Further studies of discoloration of EVA encapsulant in photovoltaic modules, Soc. Plast. Eng., 3260-3264, Indianapolis, IN.
15. Ezrin, M. and G. Lavigne. 1996. Safety-related failure of polyethylene products, Soc. Plast. Eng. ANTEC, 3272-3274, Indianapolis, IN.
16. Ezrin, M. 1996. Plastics Failure Guide - Cause and Prevention, Hanser Publ., 473 pages.
17. Ezrin, M. Design Watch - Gallery of Goofs, Plastics World, contributing editor, bimonthly series February 1996 - September 1997.
  1. The many causes and faces of plastics failure, February 1996, 27-28.
  2. Unraveling the 'mystery' behind part failure, April 1996, 31-32.
  3. Those mischievous molecular monsters, June 1996, 23-24.
  4. The high cost of part failure, August 1996, 25-26.
  5. When 1 + 1 = 10, October 1996, 29-30.
  6. The three amigos of part failure, success, December 1996, 25-26.
  7. Plastics failure/people failure, February 1997, 17.
  8. Some effects of design in part failure, April 1997, 19-20.
  9. Processing can be major contributor to part failure, September 1997, 16.
18. Klemchuk, P., M. Ezrin, G. Lavigne, W. Holley, J. Galica and S. Agro. 1997. Investigation of the degradation and stabilization of EVA-based encapsulant in field-aged solar energy modules, Polymer Degradation and Stability, 55, 347-365.
19. Ezrin, M. 1997. Processing - Key to preventing plastic part failure, Medical Design and Manufacturing Conference, November 6, 1997, Section 304, Minneapolis, MN.
20. Ezrin, M., G. Lavigne and J. Helwig, 1998. Product failure due to design, material and processing problems, Soc. Plast. Eng. ANTEC, 3147-3150, Atlanta, GA.
21. Ezrin, M. and G. Lavigne, 1999. Case studies of failure related to improper formulation, Soc. Plast. Eng. ANTEC, 3346-3349, New York.
22. Ezrin, M., A. Zepke, J. Helwig, G. Lavigne and M. Dudley, 2000. Plastics failure due to oxidative degradation in processing and service, Soc. Plast. Eng. ANTEC, Orlando, FL.

**ELECTRICAL INSULATION**

23. Katz, C., A. Dima, A. Zidon, M. Ezrin, W. Zengel and B. Bernstein. 1984. Emergency overload characteristics of extruded dielectric cables operating at 130°C and above, IEEE Transactions on Power Apparatus and Systems, Vol. PAS-103, No. 12, 3454-3463.
24. Ezrin, M. 1984. Electrical insulation research at the University of Connecticut, Conference Proceedings of the non-ferrous electrical division meeting, Wire Association International, Providence, RI, May 21-23, pp. 24-40.
25. Ezrin, M. and J. Gartner. 1984. Test method for evaluation of the resistance of fiberglass rods to combined mechanical and chemical stress, IEEE Transactions on Power Apparatus and Systems, Vol. PAS-103, No. 9, 2741-2745.
26. Ezrin, M., D. Seymour, C. Katz, A. Dima and B. Bernstein. 1986. Thermal response of cable insulation, shield and jacket materials aged at 130°C and above, Conf. Record of the 1986 IEEE International Symposium on Electrical Insulation, 47-49, Washington, DC.
27. Ezrin, M. and D. Seymour. 1988. Characterization of unforeseen effects of thermal aging on power distribution cable insulation, Soc. Plast. Eng. ANTEC, 889-892, Atlanta.
28. Ezrin, M. and B. Bernstein. 1988. Application of a sealed tube test to the study of degraded insulation resulting from thermal aging of cables with PVC jacket, Conference Record of the 1988 IEEE International Symposium on Electrical Insulation, 215-218, June, Boston.
29. Ezrin, M. and S. Gruchawka. 1993. Applications of thermal analysis to electrical insulation, Eastern Analytical Symposium, Nov. 17, 1993, Somerset, NJ.

**SOLAR PANEL ENCAPSULANT DISCOLORATION**

30. Ezrin, M., G. Lavigne, P. Klemchuk, W. Holley, S. Agro, J. Galica, L. Thomas and R. Yorgensen. 1995. Discoloration of EVA encapsulant in photovoltaic cells, Soc. Plast. Eng. ANTEC, 3957-3960, Boston, MA.
31. Ezrin, M., G. Lavigne, P. Klemchuk, J. Pickering, W. Holley, J. Galica, S. Agro, W. Nelson and Q. Wu. 1996. Further studies of discoloration of EVA encapsulant in photovoltaic modules, Soc. Plast. Eng., 3260-3264, Indianapolis, IN.
32. Klemchuk, P., M. Ezrin, G. Lavigne, W. Holley, J. Galica and S. Agro. 1997. Investigation of the degradation and stabilization of EVA-based encapsulant in field-aged solar energy modules, Polymer Degradation and Stability, 55, 347-365.

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**SPE PLASTICS SHORT COURSES IN RHODE ISLAND IN MARCH 2000**

The following SPE plastics courses are scheduled for March 27-31, 2000 at the Sheraton Providence Airport Hotel in Warwick, Rhode Island:

March 27 — *Fundamentals of Plastic Materials and Processing* by Jean-Michel Charrier

March 27-28 — *Flexible PVC Compounding, Its Formulation and Manufacture* by Jesse Edenbaum

March 27-28 — *Production Injection Molding* by William Frizelle

March 28 — *Extrusion: An Intensive Introduction* by Allan Griff

March 29 — *Troubleshooting the Extrusion Process* by Allan Griff

March 29-30 — *Injection Molding Technology* by William Frizelle

March 29, 30 and 31 — *Injection Molding - Advanced Concepts and Analyses* by Lawrence Schmidt

March 30-31 — *Die Design Principles for Extrusion of Polymers* by Leonard Sansone

Seminar hours are from 8:30 a.m. through 4:30 p.m. daily.

Refreshment breaks along with a sit-down lunch is provided by SPE during the day.

SPE has contracted special sleeping room rates for attendees at the Sheraton Providence Airport Hotel for \$109.00 single/double plus 12% tax.

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