TPM&F
Thermoplastic Materials and Foams

A divisional newsletter of the Society of Plastics Engineers

June 2012

TPM&F SCOPE

The Thermoplastic Materials and Foams Division is organized to provide a focal point for the interchange of information relating to non-vinyl thermoplastic resins including fluoropolymers, polyamides, polyesters, polyolefins, polystyrenes, polyurethanes, their filled and/or reinforced products, and their foamable and foamed products. Its interests lie in stimulating the development of scientific and engineering knowledge. By encouraging participation between producers and consumers, it aims to provide information on new developments which shall encompass synthesis, characterization, fabrication, safe handling, application, serviceability, and marketing.

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Communications Excellence Award

CHAIRMAN'S MESSAGE

As I start my second year as a Chairman of the Thermoplastic Materials and Foams Division, I would like to thank the Board of Directors for successfully completing the three major goals of the division.

1) Going live with a new division website by April 1, 2012
2) Attaining the Special Recognition Level Communications Excellence Award.
3) Commitment to hold the FOAMS®2012 Conference outside of North America.

There was excellent attendance at our April 3rd Board Meeting and Tricia McKnight and Lauren McCarthy, (SPE headquarters) joined as guests. Following are some of the highlights from that board meeting.

At the start of the meeting, we honored our long-time board member, Henry (Hank) Schirmer. Ray Shute presented an Inaugural Honorary Lifetime Member of the Board Award to Hank. This is the first time the Board has presented such an award and recognized a fellow board member for his contributions to the Division and SPE.

Ray Shute, Nomination Chair, shared the recent election results. I would like to congratulate and welcome Ajit Ranade as our new board member. Ajit will continue to lead with the Membership Chair position for the division. I am also pleased to inform that Gary Wilkes, Packaging Specialist of Dart Corporation, has joined the TPM&F board as an ad-hoc member.

The TPM&F division's business meeting and members' reception were both held on April 3rd. It was good to meet with some of the members who were able to attend the reception.

Please note the address for the new website is www.spetpmf.com. Please check out this new website and send your comments or questions through the new site. Theresa Healy, Communication Chair, will be very happy to receive your input for the new website.

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BOARD OF DIRECTORS LISTING

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EUROPEAN ACTIVITIES CHAIR

CHAIRMAN'S MESSAGE

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Donna Davis, TPC for ANTEC®, organized six TPM&F sessions. Thanks to Donna for organizing these sessions. Two papers from the TPM&F sessions were selected by Dale Grove, Best Paper Chair, to receive Best Paper Award. Please see details on these two papers in the newsletter.

Our Division is committed to supporting various educational activities - a Platinum Sponsor of student activities held at ANTEC® 2012.

Max Wingert, Treasurer, reviewed options and made a recommendation to invest a TPM&F fund with Constitution Advisory Group, but under direct supervision of the TPM&F division. Please note the funds are no longer managed by the SPE headquarters. The motion was approved by the Board to invest the funds with the firm.

Miguel Rodriguez-Perez, FOAMS®2012 Chair, has finalized a venue and already identified several sponsors for the event. The conference will offer a great opportunity to meet and network with TPM&F members located outside North America, so please make plans to attend this conference.

Our next board meeting will be held on June 22, 2012 (8:00–9:30 a.m. EST) by teleconference. The main goal of the meeting is to connect with our board members located outside North America and to review all international activities.

Please feel free to contact any board member or me if there are any questions or suggestions. I wish everyone a happy and productive summer!

Sincerely,

Perry Vadhar

UPCOMING SPE TPM&F EVENTS

NEXT SPE TPM&F BOARD MEETING

June 22, 2012
(8:00–9:30 a.m. EST) by teleconference. All members are invited to join in person or by teleconference. The meeting main purpose is to discuss "TPM&F Division International Activities". The meeting time is 8:00 to 9:30 a.m. EST.

FOAMS® 2012

September 10 - 11 (Tutorials)
September 12 - 13 (Conference)
Hotel Porta Fira Barcelona, SPAIN

SPE TPM&F BOARD SEPTEMBER MEETING

1:30 p.m. to 3:30p.m. EST. *(7:30 to 9:30 p.m. Barcelona Time).* This is a tentative time.

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France Toll-Free	0 800 942 830	**Slovak Republic** Toll-Free	0800 001 806
Paris (local)	+33 (0) 1 70 70 17 71	**Slovenia** Toll-Free	0 800 80302
Germany Toll-Free	0 800 664 6296	**Ljubljana** (local)	+386 1 600 3131
Frankfurt (local)	+49 (0) 69 2222 10760	**South Africa** Toll-Free	0800 983 713
Greece Toll-Free	00800 128 514	**Spain (Barcelona)**	+34 93 545 2527
Hong Kong Toll-Free	+852 3051 2702	**Sweden (Stockholm)**	+46 (0) 8 5352 6446
Hungary Toll-Free	06 800 191 15	**Switzerland** Toll-Free	0 800 001 225
Iceland Toll-Free	800 9718	**Geneva** (local)	+41 (0) 22 592 7597
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COMMUNICATION CHAIR REPORT

by: Theresa Healy

www.SPETPMF.com

NEW WEBSITE

As you all know, my team and I have been working on a new website for the TPM&F Division. The goal of this website is to keep our members and interested parties involved in new happenings within our division as well as the SPE. The new website is ready for start-up. I would encourage all of you to look over this site and send me an e-mail with any comments, suggestions, changes, feedback, etc…This is our first initial set up and the second step is going to be the management of the site which should happen in early March. This will allow a few of us to edit the site as needed and make the necessary changes to the content. The new website address is going to be www.spetpmf.com. You can view the website by clicking the following link:

http://spetpmf.com/Index.asp?Pg=Ho

As we get more involved in the function of the website, we will add /modify content. I would like to use this as another tool to communicate with our members as well as anyone interested in our division as well as the SPE.

In addition to our new website, we are continuing to gain members to our TPM&F Linked-In site. I would like us to feel free to share in any technical discussions and questions concerning thermoplastic material and/or foams. This can be a very useful tool in helping companies solve problems or at least provide resources and feedback for technical problems faced in our industry. All discussion should be relevant to what we do and anything out of scope of the initial intent will be monitored and removed if needed. Let's make the Linked -In site more productive and resourceful.

We can promote our new website on the Linked In site for people to view for more information about the division and its events. As of today, we have about 300 members on our site which is more than double this time last year so there is plenty of interest in this group and it continues to grow.

EDUCATION CHAIR REPORT

by Hani Naguib

1. The TPMF Division education program is supporting student activities during ANTEC® 2012 which includes platinum sponsorship for the student receptions.

2. The TPMF Division has sponsored student scholarships *(two students at PO2012).*

3. Suggested plan for FOAMS® 2012: TPMF to support two students scholarships during FOAMS® 2012.

4. Suggested plan for new Webinar series: the division is interested to organize some specialized webinar series in state of the art areas in the plastics field, we would like to have volunteers from the board members and industry for conducting webinar series in 2012 in the area of sustainability, bio based thermoplastics.

5. Suggested plan for more educational activities:
i) providing schools with some educational plastics videos and samples ii) starting a youth outreach program for high school students during our board Topcon conferences; iii) provide travel scholarship to university students to attend our Topcon conferences.

Stephen Johnston (UMAS Lowell) right, presents TPM&F with acertificate in appreciation of our Division's platinium sponsorship during ANTEC®

INAUGURAL HONORARY LIFETIME MEMBER OF THE BOARD AWARD PRESENTED TO HENRY G. SCHIRMER

During the Thermoplastic Materials and Foams Division ANTEC® Board meeting on April 3, 2012, Hank Schirmer was presented with the Inaugural Honorary Lifetime Member of the Board Award.

Hank joined SPE in 1969 and has been a member and officer of the board for over 40+ years. He has been an officer, member, and mentor to many of the newer board members. Encouraging them to participate and become active on the board. He has presented technical papers at numerous ANTEC® meetings, and at the Polyolefin Topcon held each February in Houston. He is an Emeritus member of SPE, a Fellow of the Society and recipient of the TPM&F Outstanding Achievement Award.

Hank was one of the most prolific innovators and inventors at W.R. Grace before he retired and then set up his own R&D company, BBS to continue his work on specialty extrusion equipment capable of producing films with multiple layers of various resins.

His many years of service, support, and continue dedication to the board is the reason we have chosen Hank to be our Inaugural recipient of our Honorary Lifetime Member of the Board Award. In the following photo, Ray Shute is shown presenting the Plaque to Hank at the Board meeting dinner.

INTERNATIONAL ACTIVITY

by Neil Witten

ONGOING ACTIVITIES
The two ongoing activities in Europe are:

FOAMS®2012
Maxwell Wingert and Miguel put out a call for posters which was available at ANTEC®. Maxwell had also passed details of the poster boards that were previously used.
Miguel had indicated that the plan was to have around 10 posters. Action: Organization needed for selection of the best poster and also for the presentation of Best Poster Award. Preparation of certificate to be awarded on the second day.

EUROTEC 2012
Olivier Crave has contacted us regarding the Eurotec 2013 organization. He has suggested that the FOAMS®2012 papers be handled by MARP & NW.

PROMOTION. Through my own LinkedIn pages, I have been posting the SPE newsletter and also show details of the FOAMS® 2012 conference.

OTHER MATTERS. Recently received an extension of the call for papers for Polymer Foam 2012 (AMI conference) – this may indicate they are having less success than we are on getting papers submitted. Have discussed but not yet scheduled a meeting with Karen Hateley. Would like to hear further from Karen about the SPE activities in Europe and how I may be able to support these activities.

ASIA
28th PPS annual meeting, Pattaya, Thailand
December 11-15, 2012: International Meeting Thailand (www.pps-28.com)

EUROPE:
- FOAMS® 2012, Sept 10-13, Barcelona
- Cellular Materials-CellMat 2012, Nov.7-9, Dresden, Germany, http://www.conventus.de/cellmat/

FOAMS® 2012 TUTORIALS REGISTRATION FORM

SEPTEMBER 10-11, 2012, MONDAY-TUESDAY

Co-Sponsored by the Spain Section & TPM&F Division Society of Plastics Engineers
Hotel PortaFira, Barcelona, Spain

NAME _____
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STATE _____ ZIP CODE_____COUNTRY_____
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Please pay Registration Fee in US Dollars by:
[ ] bank transfer [ ] check [ ] credit card

Credit Card Payment: _____
Cardholder Name: _____
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Expire Date: _____
Signature: _____

SPE Member Fees
(Advance date Sept. 1, 2012):
$ 390 Advance / $ 600 On-site for Tutorial
$ 470 Advance/ $ 680 On-site for Conference
$ 760 Advance/ $ 970 On-site for both Tutorial and Conference.

SPE Non-Members:
(Advance date Sept. 1, 2012):
$ 600 Advance / $ 815 On-site for Tutorial
$ 680 Advance/ $ 890 On-site for Conference
$ 970 Advance/ $ 1180 On-site for both Tutorial and Conference

Please call, mail or fax this form to:
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Society of Plastics Engineers
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Tutorials Outline
DR. S.T. LEE
Overall Review: Thermoplastic and Thermoset Foams
Reactive Foaming: Mechanisms and methods Structures and Properties
Applications
PROF. CHUL B. PARK
- Design of Foam Structures
- Foaming Agents
- Fundamentals of Continuous Microcellular Foaming
- Control of Cell Nucleation
- Control of Foam Density

PROF. HANI E. NAGUIB
- Biofoams: processing, properties, and applications
- Nanocomposite Foams: processing, properties, and applications
- Sustainable Foams: processing, properties, and applications

Tutorial starts 14:30 PM Monday, September 10 and ends 6:30 PM Tuesday, September 11 2012.

Hotel room reservations may be made at the special SPE rate of US$118/night + 8% taxes *(breakfast included)* by contacting:

HOTEL PORTA FIRA
Plaza Europa, 45, L' Hospitalet
Barcelona 08908
Spain
T: + 34 902 270127
F: + 34 932973509
email: reservasportafira@h-santos.es
Rate applies for single occupancy and for bookings before August 10th 2012
Cancellation policy is before August 10th no penalty, after August 10th one night room and tax will be charged, after August 26th 100% will be charged
Check-in time is 4:00pm and after.
Check-out time is by 12 noon.

FOAMS® 2012 REPORT

By Miguel Angel Rodríguez Pérez

1. FOAMS® 2012 COMMITTEE.

Conference Chair – M.A. Rodriguez-Perez.
Conference Co-Chairs – Miguel Muñoz and Karen Hately.
Technical Program Chair - M.A. Rodriguez-Perez.
Technical Program Co-Chairs – Vipin Kumar and Neil Witten.
Housing Chair – Karen Hately and Lauren McCarthy
Hotel Contract Chair – Karen Hately.
Tutorial Chair – Professor Chul Park
Sponsor Chairs – Theresa Healy, Salvatore Monte and Magnolia León
Student Poster Chair – Neil Witten and Maxwell Wingert
Treasurer – Miguel Muñoz and Max Wingert
Best Paper Award – Dale Grove
Local Organizing Committee: Cristina Saiz, Belen Notario and Ester Laguna.

Three persons of CellMat Laboratory (Cristina Saiz, Belen Notario and Ester Laguna) will help the organizing committee during the conference. They will be on-site to collaborate in all activities needed (during registration, informing the attendees, etc). Best paper award. Dale has to inform us if he needs help of some people attending the conference.

Treasurer. Miguel Muñoz , president of the local section of SPE, will be the treasurer, assisted by Max Wingert

Housing chair. Lauren McCarthy has informed that she will attend the conference to help in this very important task. She will have enough help from local persons (the three persons from CellMat previously mentioned Lab will help Lauren).

Miguel will be in charge of having all the facilities ready in the hotel for Lauren. This is the Email send from Lauren on 23/02.

I will be bringing all badge stock, badge holders, lanyards, and ribbons with me. I will need a table, preferably with enough room to seat two people in case someone else would like to be manning the desk with me. I will need a printer along with the appropriate cables to connect to my laptop because I will need to print badges for on-site registrants. I will bring enough on-site registration forms with me so we should be good on that end. I will need a hard-wired connection to process any onsite applications so that monies are going over a secured connection. I will send you a picture of what we typically do within the US for the signage and then we can discuss what you all would like. I will most likely be sitting at the registration desk all day with the exception of meals where I would need someone to cover for me, but typically I just bring them back to the desk and eat there if that is okay with everyone else.

2. HOTEL

Negotiations with two hotels are being done. Hotel Porta Fira and Hotel Renaissance are the candidates to place the conference. Current situation is as follows:

PORTA FIRA:
Total budget 30 people in the Tutorial and 100 people in the conference: 21550.31 euros.
Payment method offered by the hotel:
First Payment on 23/03/2012, 4.310,00 euros (20,00 %)
Second Payment on 23/07/2012, 10.775,00 euros (50,00 %)
Third Payment on 10/08/2012, 6.465,31 (30,00 %)
The second and third payment are too early.
Price per room: (single room): 97.2 euros, breakfast included. This is a very good price for this hotel

RENAISSANCE:
Total budget for 30 people in the Tutorial and 100 people in the conference: 20800 euros.
Payment method:
First payment: 5.000 € berore April 16th
Second payment before August 27th
Rest, two days before the conference starts.
Must better payment agenda for us.
Price per room: (Single room): 118,8 breakfast included.

We have visited both hotels and we consider that both are satisfactory to organize the conference being the facilities of Porta Fira slightly better. In addition, this hotel is located closer to the city centre. Renaissance is near Barcelona airport.

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Next action (Miguel and Karen in charge): Negotiating the payment terms of Porta Fira (difficult to accept now) and reduce the cost to values similar to those of Renaisance. If Porta Fira does not accept a payment method similar to that of Renaissance we will consider organizing the conference in Reinassance.

3. PAPERS.

To date Four papers have been received - better figures than in previous years at this time. These are the titles of the papers, all from Europe.

1. Influence of Nanofiller Shape on Foam Morphology in Supercritical CO_2 Assisted Foaming
   Rahmi Ozisik[1], Deniz Rende1,[2]
   [1]Dept. of Materials Science and Engineering, and Rensselaer Nanotechnology Center, Rensselaer Polytechnic Institute, Troy, NY 12180, USA, [2]Dept. of Chemical Engineering, Yeditepe University, Istanbul 34755, Turkey
2. Foaming of a Toughness Modified Recyclable Polymer
   Marieluise Stumpf, Prof. Dr. Volker Altstädt
   Lehrstuhl Polymere Werkstoffe, Universität Bayreuth, Universitätsstraße 30, 95447 Bayreuth
3. Foam Extrusion Behavior and Correlation between Foam Morphology and Foam Properties of Externally Plasticized Cellulose Acetate Using Inert Gases
   K. Berdel[1], T. Hildebrand[1], S. Kabasci[2], H.-J. Radusch[3], F. van Lück[4], T. Wodke[2], S. Zepnik[2,3]
   [1]Institute of Plastics Processing (IKV), RWTH Aachen University, Aachen, Germany
   [2]Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT, Oberhausen, Germany
   [3]Martin Luther University Halle-Wittenberg, Centre of Engineering Sciences, Chair Polymer Technology, Halle (Saale), Germany
   [4]Inde Plastik Betriebsgesellschaft mbH, Aldenhoven, Germany
4. Chemical Foaming of Thermoplastics
   Dr. Thomas Mergenhagen
   TRAMACO GmbH, Siemensstraße 1-5, 25421 Pinneberg
5. Foaming Properties of Novel PS Food Contact Complying Nanoclay-based Composites
   J .M. LAGARON, IATA-CSIC, Avda. Agustin Escardino 7, 46980 Paterna, Spain Phone/Fax/E-mail: +34 963900022, e-mail: lagaron@iata.csic.es,E. NUÑEZ, NanoBioMatters R&D S.L., Paterna, Spain, J. LOBOS, M.A. RODRIGUEZ-PEREZ, Cellular Materials Laboratory, Condensed Matter Physics Department, Universidad de Valladolid, Valladolid, Spain
6. Titanates and Zirconates – Why They Are Different Than Silanes at The Interface"
   Salvatore Monte, Kenrich Petrochemicals.
   140 East 22nd Street PO Box 32 Bayonne, NJ 07002 USA Email: sjmonte@4kenrich.com
7. A Novel Continuous Kynar® PVDF Foam Concentrate and Application Developments
   Sean M. Stabler, Saeid Zerafati, Richard Perrinaud - Arkema Inc.
   900 First Avenue, King of Prussia, PA 19406
8. Effects of Cellular Morphology on Electrical Conductivity of Carbon Nanotubes Containing Nanocomposite Foams
   Minh-Phuong Tran1, Jean-Michel Thomassin[1], Michaël Alexandre1, Erwan Plougonven[2], Angelique Leonard[2], Christophe Detrembleur[1]
   Dept.of Chemistry, Center of Research and Education on Macromolecules (CERM), University of Liège, B6aAllée de Chimie, SartTilman, 4000 Liège (Belgium)
   [2]Dept. of Applied Chemistry, Laboratory of Chemical Engineering, University of Liège, B6aAllée de Chimie, SartTilman, 4000 Liège (Belgium)

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4. PLENARY SPEAKER

Dr. Klaus Hahn from BASF, TPM&F Outstanding Achievement Award, will give a plenary lecture during FOAMS® 2012. He will receive the award during the conference.

5. SPONSORS

The following sponsors are confirmed: Kenrich Petrochemicals, BASF-Spain, Total Petrochemicals.
Next actions: Miguel Muñoz to set the bank account for the conference.
Decide if the money is transferred to this bank account of the local section.
To transfer the seed money and to make effective the payment of the sponsors (Theresa and Miguel Muñoz)

6. PROMOTION OF THE CONFERENCE.

First email blast was already submitted. Web site is working. The conference has been announced in several local media and web sites of collaborators. An announcement of the Plastic Engineering Magazine, a brochure describing the main aspects of the conference. This document could be used to promote the conference in other SPE events. A poster announcing the conference. This could be used to promote the conference in other events. It is needed to produce post-cards to invite SPE members to participate. It is needed to edit a Tutorial Trifold – Program for attendees and promotion (need input from Professor Park)
Note: Probably only the post-card or the brochure is needed. To decide what is the best option.
Next actions.
To improve the documents (all the FOAMS® 2012 Committee),
To include the advertisement in the Plastic Engineering Magazine -depending on charge if there is one.
- Printing the brochure or the post-card and sending it (Sal/Theresa)
- Printing the poster. (Karen)
- To prepare a second email blast (Karen)
- Edit the Tutorial Tri-Fold (Miguel /Chul)

7. PAPER WORK.

It is needed to review and finalize petition for FOAMS® 2012 Barcelona created by Sal Monte. (Miguel in charge of this).

8. TUTORIAL

Miguel to contact Chul Park to start with the organization and promotion of the tutorial.

9. POSTER SESSION.

Neil Witen and Max Wingert have started to work on this. Promotion of the poster session will start at ANTEC® conference. Miguel in charge of having enough space in the hotel and poster boards in the hotel ready for the poster session.

10. CONFERENCE CALLS OF THE COMMITTEE.

It is needed to schedule Conference Calls for Committee: Once a month in May, June and July and then bi-weekly Aug. thru Sept. Perry and Miguel to organize this.

11. OTHER ASPECTS.

Here are some additional aspects to take into account. This is from an email from Sal Monte (on March 30, 2012)

We have a list of "to-do's" by Peacock:
- Postcard Mailing.
- USB stick for attendees (need completed submitted papers).
- Tutorial Trifold – Program for attendees & promotion (need input: Prof.Park).

Conference Trifold – Program for attendees and promotion (need Paper Titles, Authors and Speakers).
Also:
Site Signage for Sponsors (Theresa Healy did this last year. Theresa can do PowerPoint signs and Miguel can have a local printer produce signs).
SPE Signs pointing to Conference, Registration Desk, Food & Beverages, etc.
Tutorial hardcopy handout of slides for Tutorial Attendees.
ORGANIZE Best Paper Award and Committee.
Housing: Hotel, food, coffee breaks, receptions.
Speaker and author Certificates and Frames.
Registration desk – badges – ribbons, tec.

TREASURER'S REPORT

by Maxwell Wingert

March 29, 2012

Financial Summary:

We were informed on Feb 1, 2012 that the SPE Investment Program ended on Dec 31, 2011. Since then, Perry and I have investigated options for investing our treasury; see below for details. Perry and I recommend a vote to choose between these options during our upcoming April 3 board meeting. My recommendation is to pursue the Constitution Advisory Group because they offer the best rate, SPE has history with them, and they offer an attractive portfolio.

FY11-12 revised budget: Income $19,000; Expenses $26,400. Thus, we have a budgeted deficit of $7,400. The budget was revised on 9/13/11 to raise the Educational Program budget by $3000. This category is currently budgeted for $8,000: $1,000 for Plastivan; $7,000 for the ANTEC Student Activities Committee --- $2,000 for a payment for the FY10-11 fiscal year and $5,000 for the FY11-12 fiscal year.

First half of FY actual transactions are: Income $8,834.45; Expenses $7,730.33.

VISION FOR SPE TPM&F TREASURY:

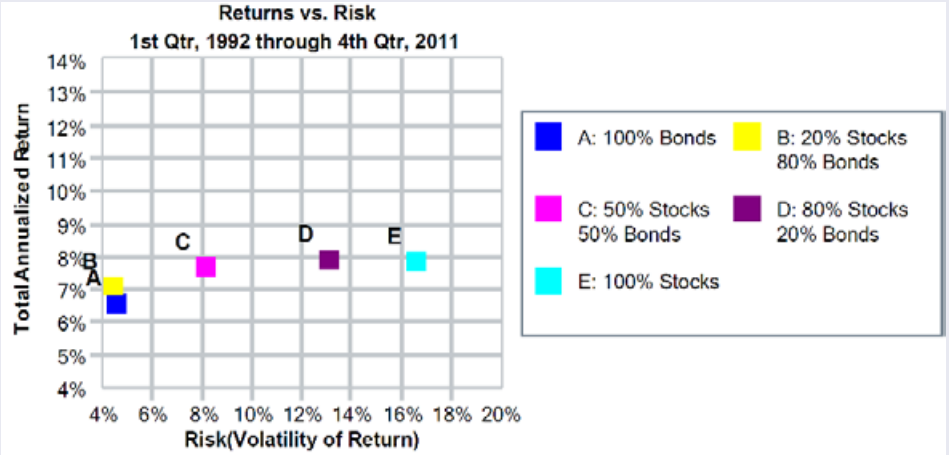
Working accounts: Checking account plus either a money market account and/or a CD ladder. Typical sum of these accounts: $10,000 to $40,000

INVESTMENT ACCOUNT:

We will choose one of the three options presented below. Initial deposit: $115,000. I don't anticipate a desire for frequent withdrawals or deposits

OBJECTIVE OF THE INVESTMENT ACCOUNT:

The objective is to allow the bulk of the treasury to grow over the long term with a diversified investment. Because the division does not need regular income from the bulk of our funds, we will forgo guaranteed yearly income for a bigger yield over the long term. As shown by the graph below taken from our proposal from PNC, a 50/50 stock/bond allocation has been successful over a long term horizon:



OPTIONS FOR THE INVESTMENT ACCOUNT:

My recommendation is to pursue the Constitution Advisory Group because they offer the best rate, SPE has history with them, and they offer an attractive portfolio.

THERMOPLASTIC MATERIALS AND FOAMS DIVISION BOARD MEETING MINUTES

Meeting Date: April 3, 2012

Location: Hilton Orlando, Winter Park Room, Orlando, FL

ATTENDANCE

Attending the BOD meeting: Ananda Chaterjee, Donna Davis, Dale Grove. Theresa Healy, Vipin Kumar, Sal Monte, Hani Naguib, Kelvin Okamoto, Chul B. Park, N. S. Ramesh, Ashu Sharma. Ray Shute, Lukas Stirnemann, Perry Vadhar, Xiaoxi Wang, and Max Wingert. *Joined by teleconfernce:* Miguel Rodriguez-Perez.

Guests: Tricia McKnight and Lauren McCarthy from SPE HQ, Gary Wilkes Dart Container.

A brief introduction made by each participant before start of the meeting.

CHAIR REPORT — PERRY VADHAR

Perry welcomed the SPE staff and guests. Among the general announcements he informed Kelvin Okamoto has resigned from the board. New TPM&F division's website went live on April 2. Perry plans to hold the next BOD meeting for 'International Activities' on June 22 from 8:00 to 9:30 a.m. EST. This will allow board members *(Neil, Miguel, and Ohshima)* to join in the meeting. The TPM&F division's long time board member, Hank Schirmer, was honored for his contributions and offered emeritus board membership. Ray Shute presented a plaque to Hank.

SECRETARY'S REPORT — LUKAS STIRNEMANN

The minutes from Feb. 26, 2012 BOD meeting was approved.

FOAMS® 2012 REPORT — MIGUEL PEREZ/ SAL MONTE/THERESA HEALY/CHUL PARK

Miguel informed the committee for Foams2012 is almost complete. Miguel Munoz will be treasurer of the conference. Dale Grove will not attend the conference. However the best 5 papers will be picked before the conference for best paper review. Lauren will be on site during the conference. Hotel negotiations are in progress and should finalize by end of the week. Payment terms and rates seem to be a challenge with the hotels. Miguel needs ideas for getting sponsors. BOD will be emailing Miguel some suggestions. Chul Park is taking care of tutorial. Perry mentioned Ken Braney made a suggestion to seek help from Djamila Oliver of SPE-Barcelona section instead of having Karen Hately (SPE-UK) to travel to Barcelona. Miguel will contact and discuss with Djamila.

OUTSTANDING ACHIEVEMENT AWARD CHAIR REPORT — VIPIN KUMAR

Dr. Hahn from BASF in Europe will be awarded OAA during FOAMS2012. Vipin is in touch with him. BASF will be one of the sponsors for the conference.

FOAMS® 2013 —A suggestion was made to hold the conference either in Chicago, IL or Seattle, WA. Donna made a motion to have FOAMS®2013 in Seattle, WA in Sept or Oct. 2013. The board approved it.

ANTEC® 2012 — DONNA DAVIS

There are six sessions sponsored by the TPM&F division. Software used for paper revision will be improved next year. Overall papers accepted for the conference have good quality. There was a concern the papers for the conference are not on a USB thumb drive and only available online. These papers will be made available to all the members on the SPE's website after six months.

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NOMINATION CHAIR REPORT — RAY SHUTE
Fifty three people voted. This is the highest ever. Everybody (7 out of 7) who ran got elected. Ajit Ranade is a new member for 2012 to 2015. Paul Arch from Nova and Gary Wilkes from Dart are on the ballot for new BOD members.

PO 2012 TOPCON REPORT — ANDY CHATTERJEE /DONNA DAVIS
Three sessions are planned for PO2013; this will raise the TPM&F division's share by 7%. Andy needs topics suggestions other than what covered at the last meeting. New ideas include Biobased Polymers, PO recycling prospects, sustainable PO, PO composites, particle foams with PO. Two scholarships given at PO2012 from 10 schools we work with – one given at the Univ. of Houston and second one at Texas Tech.

COUNCILOR CHAIR REPORT — ASHU SHARMA
Ten years needed to become Senior Member and six years to become Honored Member. New SPE CEO will come out of Europe. Member count stagnate at 15000. *(compared to 30,000 in the '90s)*.

COMMUNICATION CHAIR REPORT — THERESA HEALY
Theresa gave update on the new website. Website is live now. URL: www.spetpmf.com. We can update/revise the content on the website in the future. Newsletters are archived on the site. A site to ask questions will be placed on the website. Donna suggested to apply for Outstanding Communication Award in 2013.

TREASURER'S REPORT — MAX WINGERT
Max reviewed proposal for managing TPM&F fund. The plan is to review and vote during this meeting. There is a 0.9% management fee but no transaction fees. Max recommends investing $115,000 of total $150,000 where higher return can be generated. This portfolio is diversified and thus conservative compared to other portfolios. Over the past 20 years, a 50/50 stock/bond portfolio like this has produced an average annual return of 7% to 8%. However, there is no guarantee of that performance. There were several questions from the board including how we are exposed to current conditions like. Euro crisis or global melt down, etc.? Can we able to close the account any time? The Palisades Section gets 6% return but there is a restriction for 25 years bond. A motion was made to place the investment of funds under consideration with an annual revision of the investment. This motion was carried with one nay by Vipin Kumar and one abstain by Donna Davis.

EDUCATION CHAIR — HANI NAGUIB
Hani made a proposal to offer scholarships to students during FOAMS® conference. Donna Davis and Andy are against giving out of scholarships coupled with the conference. The sponsorships shall be by the division itself. Would this be 2 scholarships of $500 per student? How will students by chosen? Hani also expressed interest to conduct one hour webinar but need some volunteers. Vipin Kumar offered to volunteer. Hani to come up with details for the two proposals – scholarship and webinar.

BEST PAPER'S CHAIR REPORT — DALE GROVE
Dale needs paper reviewers for ANTEC® papers.

COUNCILOR CHAIR REPORT — ASHU SHARMA
Ashu will send his report once he receives the meeting minutes.

MEMBERSHIP CHAIR REPORT — AJIT RANADE
We have lost several members in last 2 years. Current count is 850 members. Ajit made suggestions to find new members. 1) Draft a personal letter to past members and ask them to renew their membership 2) Use the website to launch a marketing campaign. 3) Announce membership benefits such as job postings on the SPE's website.

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MEETING MINUTES - CONTINUED

NEWSLETTER CHAIR REPORT — XIAOXI WANG
In the next newsletter (publish mid May) he will include new board members.

REVISION OF TPM&F BY-LAWS — RAY SHUTE
Ray Shute has stepped in to review the by-laws replacing Kelvin Okamoto. He will update the by-laws and send them out to the BOD members. Theresa will help with setting up a "Drop Box" website where all the documents for the division will be archived.

HSM/FELLOWS NOMINATIONS — DONNA DAVIS
No update on the fellow nomination.

INTERNATIONAL ACTIVITIES REPORT — MASAHIRO OHSHIMA & NEIL WITTEN
There will be a BOD meeting on June 22 to accommodate overseas members for a short meeting for their board input.

NEW/OLD BUSINESS
No additional topics. Ray Shute: Wants to nominate Gary Wilkes to fill in a vacant position *(Kelvin's old position)*. Perry will accept Gary to be on the board of directors.

Next full Board meeting tentative date is on September 11 at 7:00 – 9:00 p.m. in Barcelona. Meeting adjourned.

submitted by Lukas Stirnemann


TPM&F Student Reception
ANTEC®2012

BEST PAPER AWARDS

Congratulations !

We are proud to announce our Best Paper winners of 2012:

FOAMS

BEST PAPER 2012 AWARD

N. Chen and C.B. Park for their paper entitled,

STRATEGIES FOR ACHIEVING HIGH EXPANSION FOAMS OF CROSSLINKED ETHYLENE-VINYL ACETATE (EVA) USING A CHEMICAL BLOWING AGENT

N. Chen and C.B. Park represent Microcellular Plastics Manufacturing Laboratory,Department of Mechanical and Industrial Engineering, University of Toronto, Toronto, Ontario, Canada M5S 3G8

THERMOPLASTIC MATERIALS

BEST PAPER 2012 AWARD

James F. Hoover, Laura G. Schultz-Hume, and Paul D. Sybert for their paper entitled,

NEW COPOLYCARBONATE COMPOSITIONS WITH LOW OSU HEAT RELEASE & SMOKE VALUES FOR AIRCRAFT APPLICATIONS

James F. Hoover, Laura G. Schultz-Hume, and Paul D. Syber represent from SABIC Innovative Plastics, 1 Lexan Lane, Mt. Vernon, IN 47620

You will find the full papers published in our newsletters, starting with this issue on the following pages. In our next issue we will be publishing James, Laura and Paul's paper, NEW COPOLYCARBONATE COMPOSITIONS WITH LOW OSU HEAT RELEASE & SMOKE VALUES FOR AIRCRAFT APPLICATIONS.

Strategies for Achieving High Expansion Foams of Crosslinked Ethylene-vinyl Acetate (EVA) using a Chemical Blowing Agent

N. Chen and C.B. Park
Microcellular Plastics Manufacturing Laboratory
Department of Mechanical and Industrial Engineering
University of Toronto, Toronto, Ontario, Canada M5S 3G8

Abstract

This paper investigates the foaming behaviour of crosslinked Ethyl-vinyl acetate (EVA) using a chemical blowing agent (CBA). In this study, foaming experiments were conducted using the chemically crosslinked polyolefin foamed BUN process, with the help of a compression molding machine. It was found that an optimum degree of crosslinking was needed to produce high quality EVA foams with high expansion ratios. A mountain-shape curve can be used to describe the relationship between the expansion ratio of the EVA foams and the crosslinking content. Furthermore, with more blowing agent used in the foaming process, the value of the optimum crosslinking content at the expansion ratio peak increases.

Introduction

Polymer has been one of the most important materials in human society, with its synthesis technology that had been developed since the early 19th century. Polymers are used in many applications, which influence every aspect of our lives. These edge advantages are due to polymers' properties, such as light weight, easy processability, isolation and other unique properties. To pursue lower density, better isolation and other related properties, foaming technology has been applied into polymers since the 1930s [1,2].

Foam is a substance that entraps on the inside, well-dispersed bubbles/cells. Polymer foams are composed of two phases, in which a blowing agent is used to generate stabilized bubble structures inside the polymer matrix. The foaming technology has been developed, and has been applied with an increasing number of different types of polymers [2,3].

Polyolefin foam is one of the important categories within polymer foams. And its areas of application include packaging, sports and leisure, toys, insulation, automotive, buoyancy, cushioning and others [4,5]. Soft polyolefin foam from crosslinked EVA comes with the property of elasticity, which is due to the ability of the long chains to reshape them back to the original configuration after the applied stress is released. Soft foams made of crosslinked polyolefin have a wide application, such as cushioned packaging materials, floatation materials, padding in various sports equipment, shock absorbers, and sports shoe soles/slippers/sandals [5-7].

Crosslinking has been used in the plastic/rubber industry because of its improvement on the physical properties of the polymer. Crosslinking is a chemical bond between adjacent polymer chains, which can stabilize bubbles during foam expansion, enhance the resistance of the cellular product to thermal collapse, and also improve the mechanical properties (such as anti-creep ability, weatherability, impact absorption, etc) of the final foamed products [3]. There are several representative processes which are used to manufacture crosslinked polyolefin foams: irradiation crosslinked foam process, chemically crosslinked extrusion foam process, chemically crosslinked polyolefin foamed BUN process, grafted resin crosslinked polyolefin foam process, injection molded foam process, and nitrogen autoclave process [3,5,8,9].

All of the above crosslinked foaming process can be composed of three major steps: mixture formation, crosslinking, and foaming (Figure 1). The foam morphology and the properties of the cellular polyolefin will be affected by the crosslinking [3]. For example, crosslinking extends the rubbery plateau of the polymer melt, and widens the temperature range in which stable foams can be produced [10]. In order to improve foam morphology and properties, and to obtain optimum foam using optimum crosslinking, it is important to fully understand the mechanism on how crosslinking affects foaming.

There have been some studies on the effects of crosslinking on the polyolefin foaming, which have been providing some insights to help further understand and develop the technology of crosslinked polyolefin foam s [11-13]. Lasman studied the expansion characteristics of peroxide-crosslinked polyethylene along with gel fraction of the polymer, and found that the gel level at the inception of foam expansion needs to be around 30-40%, in order to get the maximum expansion ratio of PE foams.

It was also found that the average cell size decreases with the increase of gel level [11]. Radiation technology has also been used to modify polymer viscoelasticity to produce foams [14-16]. Similar "mountain shape" trends were observed on the foaming results of radiation crosslinking experiments [16]. Crosslinking over 45% caused a foam split phenomenon, which restricted the foam expansion. Crosslinking below 20% caused cell rupture. With a given amount of blowing agent in the experiments, crosslinking between 30%-40% leads to the highest expansion ratio of POE/LDPE bends [16]. Marcilla et al. studied the crosslinked foaming of PE at atmospheric pressure, and found there was an optimum crosslinking agent amount to produce PE foams with lowest density [13].

Although the crosslinked polyolefin/EVA foaming technology has been used successfully by industries, the continuous development of foaming technologies requires accurate knowledge of the influence of processing parameters and especially how crosslinking influences the EVA foaming. The needs of both the industrial development and academic exploration fields lead to this proposed research, in which the crosslinked EVA foaming process was optimized to improve the cell morphology with the understanding of the mechanism of crosslinked EVA foaming.

In this research, batch foaming experiments were conducted to optimize the maximum expansion ratio of crosslinked EVA foams. CBA and chemical peroxide crosslinking agent were used in the experiments. The influence of crosslinking on the cell morphology was studied. The relationship between the maximum expansion ratio and crosslinking agent mount was presented. The previous research results of the author and the coworkers were applied to understand the phenomena [17-19].

Experimental

Material

Ethylene-vinyl acetate (EVA) (Elvax 360) with a vinyl acetate weight content of 25% was supplied by DuPont Inc. This EVA resin is in a pellet form and has a melt index of 2g/10min. The melting point of this EVA is about 78°C based on the DSC data conducted. The CBA used was *Celogen® OT*. The crosslinking agent used in this study was Di-Cup 40C supplied by R. T. Vanderbilt Inc. It has a di-cumyl peroxide (DCP) weight content of 40% and a decomposition temperature of 120°C.

Experiments

Figure 2 shows the batch foaming procedure. Polymer pellets, blowing agents and crosslinking agents were compounded together. The mixing process made the blowing agents and crosslinking agents evenly distribute into the polymer matrix, without any premature decomposition. The rotational rheometer was applied here to examine the compounding distribution uniformity by measuring the modulus, which would be enhanced by crosslinking. Next, the compounded plastic melt was melted and shaped in the cavity of the mold, which was made up of the male and female mold parts clamped shut by the hydraulics. The mold temperature was then increased. After a certain amount of hold time, the male and female mold parts were opened. A foamed product is obtained and is cooled in open air.

The densities of the foamed EVA/DCP samples were determined by weighting in water and in air, using a balance with a resolution of 10^{-4} g, according to ASTM D792.

For microstructural analysis, the foamed samples were analyzed by SEM. The samples were first sectioned in liquid nitrogen and then coated with gold using a sputter coater (Polaron Range SC 7620). The morphology of the fracture surface was studied by using a JEOL JSM6060 scanning electron microscope operating at 20 kV.

The expansion ratio ($_1$) was calculated as the ratio of the bulk density of pure polymer (ρ_p) to the bulk density of foamed sample (ρ_f) as shown in Equation 1. The void fraction (V_f) was calculated as shown in Equation 2. The number of cells (n_c) could be defined in the SEM pictures in an area ($l \times l$). Cell density n was calculated as the number of cells per unit volume with respect to the un-foamed polymer (Equation 3).

$$v_e = \frac{\rho_p}{\rho_f} \quad (1)$$

$$V_f = 1 - \frac{\rho_f}{\rho_p} \quad (2)$$

$$n = \left(\frac{n_c}{l^2}\right)^{3/2} \times 10^{12} \times v_e \quad (3)$$

Differential scanning calorimetry DSC was used to study the crosslinking degree of the polymer by measuring the residual curing enthalpy [20,21]. The heat of the partially cured resin is compared with the heat

when the uncured resin is fully cured (Figure 3). The curing percentage was calculated through:

% cured relative to fully cured = (Uncured Enthalpy Change - Residual Enthalpy Change)*100/(Enthalpy Change from Uncured to Fully Cured)

Experiment Results and Discussion

The effects of the CBA content on the foaming of crosslinked EVA were investigated firstly (Figure 4). The amounts of the CBA were set to be 1phr, 2phr, 3phr, 4phr, 6phr. The other parameters were: 190°C foaming temperature, 1.6phr crosslinking agent, 2.4phr calcium carbonate as nucleation sites and 6min curing time. Figure 4 illustrates the relationship between the cell morphology and the CBA content. The cell density increases With CBA increasing; the foam density decreases, and the expansion ratio increases. CBA content increases, providing more gas used for generating bubbles. With all other parameters remaining constant, the cell density gradually goes to a plateau value.

The effects of the crosslinking agent content on the foaming of crosslinked EVA were also investigated (Figure 5). The amounts of the crosslinking agent were set to be 0.08phr, 0.4phr, 0.8phr, 1.2phr, 1.6phr. The other parameters were: 170°C and 190°C foaming temperature, 1.6phr crosslinking agent, 2.4phr calcium carbonate as nucleation sites and 6min curing time. Figure 5 illustrates the relationship between the cell morphology and the crosslinking agent content. The cell density increases with crosslinking agent increasing; the foam density decreases; and the expansion ratio increases. CA content increases, providing higher melt strength, which is vital to get a nice foam.

The effects of crosslinking on the foaming can be explained using the established cell growth model and the previous fundamental measurement data.

A bubble model in foaming is presented in Figure 6 to describe the diffusion-induced growth of a gas bubble surrounded by a thin film of viscoelastic liquid [22]. Equations (momentum equation (Equation 4); constitutive equations (Equation 5, 6)) have been applied in the foaming model to describe the bubble growth procedure, which has a reasonable match with the experimental results [23]. The mass balanced equation (Equation 7) and the diffusion equation (Equation 8) are applied to describe the mass transportation of the gas molecular [22,23]. In Equation 4-8, P_g is the bubble pressure; σ is the surface tension; R is the bubble radius; R_{shell} is the radius of the outer volume; $\tau_{rr} - \tau_{\theta\theta}$ is the normal stress difference in the melt; λ is the relaxation time; η is the viscosity; R is the bubble radius; c is the gas concentration; D is the gas diffusivity inside the polymer.

$$P_g - \frac{2\sigma}{R} - P_f + 2\int_R^{R_{shell}} (\tau_{rr} - \tau_{\theta\theta}) \frac{\mathrm{d}r}{r} = 0 \tag{4}$$

$$\frac{d\tau_{rr}}{dt} = -\left(\frac{1}{\lambda} + \frac{4R^2\dot{R}}{y+R^3}\right)\tau_{rr} - \frac{4\eta}{\lambda}\frac{R^2\dot{R}}{y+R^3} \tag{5}$$

$$\frac{d\tau_{\theta\theta}}{dt} = -\left(\frac{1}{\lambda} - \frac{2R^2\dot{R}}{y+R^3}\right)\tau_{\theta\theta} + \frac{2\eta}{\lambda}\frac{R^2\dot{R}}{y+R^3} \tag{6}$$

$$\frac{d}{dt}\left(\frac{4\pi}{3}\frac{P_g R^3}{\Re T}\right) = 4\pi R^2 D \frac{\partial c}{\partial r}\bigg|_{r=R} \tag{7}$$

$$\frac{\partial c}{\partial t} + u(r)\frac{\partial c}{\partial r} = \frac{1}{r^2}\frac{\partial}{\partial r}\left(Dr^2\frac{\partial c}{\partial r}\right) \tag{8}$$

In our previous study [18], crosslinking increases the shear and extensional viscosity of the polymer. It prevents the wall rupture and cell coalescence, as the cell walls of the foam experience biaxial stretching during the bubbles' expansion. Both the solubility and diffusivity of the blowing agent in the crosslinked EVA decreases with the crosslinking degree because of less free volume [19]. The lower diffusivity makes less blowing agent to leak outside, which helps with bubble generation. Furthermore, higher viscosity and lower diffusivity make bubble grow slower, which leaves more blank polymer space to generate more bubbles.

Insufficient crosslinking results in bubble rupture and gas loss, while excessive crosslinking restricts foam expansion. In this study, more effects have been made to investigate the optimum crosslinking for large foam expansion. An optimum crosslinking prevents bubble rupture and enhances the efficiency of blowing agent. Furthermore, it does not restrain the expansion of the cells.

Figure 7 shows the optimization of maximum expansion ratio of crosslinked EVA in the batch foaming experiments. The foaming temperature was set to be 170°C, the talc powder was chosen to be the nucleating sites at 2.4phr and the curing time was set to be 6min. The curing percentage was characterized using a DSC machine (Figure 8). The relationship between foaming morphology and the curing percentage was presented in Figure 9.

It is observed that there exists an optimum value of crosslinking agent amount for a fixed amount of chemical blowing agent. When the crosslinking amount is low, the melt strength is weak, not high enough to hold the bubble structure. This is the reason foam with low expansion ratio and low cell densities are obtained when the crosslinking agent amount is low. When the crosslinking agent amount increases, the cell density and expansion ratio increases. With excessive crosslinking agent amounts, the expansion ratio of the foams decreases. This is because too much crosslinking restrains the bubble growth in the foaming. Therefore, a mountain shape curve exists to describe the relationship between the foam expansion ratio and crosslinking agent amount. This is similar to the relationship between the foam expansion ratios and die temperatures in the foam extrusion [24]. Furthermore, when the blowing agent used for the foaming increases, the value of the optimum crosslinking agent, which is to obtain foams with maximum expansion ratio, also requires to be increased.

Summary and Conclusions

In this study, experimental studies are carried out to investigate the foaming feasibility of crosslinked EVA and the processing parameters have been optimized to maximize the expansion ratio of the crosslinked EVA using a CBA. There exists an optimum value of crosslinking degree to obtain the maximum expansion ratio of EVA foams, while other processing parameters are constant. The expansion ratio of the EVA foams is low when the crosslinking content is in the very low range, because the melt strength is not strong enough to maintain the cell structure. When the crosslinking content is excessive, the expansion ratio of the EVA foams is also low because the cell growth is restrained by high melt strength. A mountain-shape curve can be used to describe the relationship between the expansion ratio of the EVA foams and the crosslinking content.

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Figures and Illustrations

Figure 1. Schematic of the foaming technology of the crosslinked plastic

Figure 2. Schematic of batch foaming process

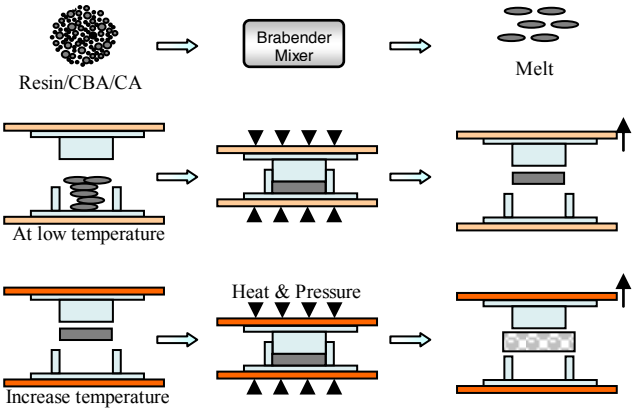


Figure 3, Crosslinking characterization [21]

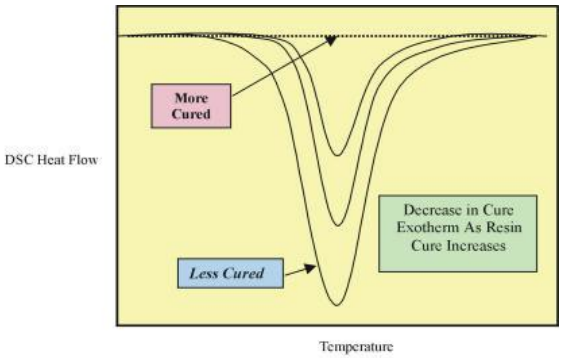
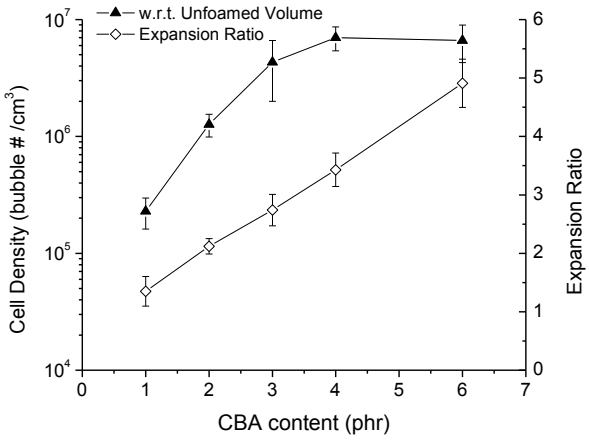
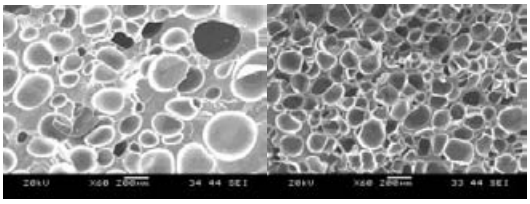


Figure 4 Crosslinked EVA foams with varying CBA contents (a) data graph (b) SEM imagines

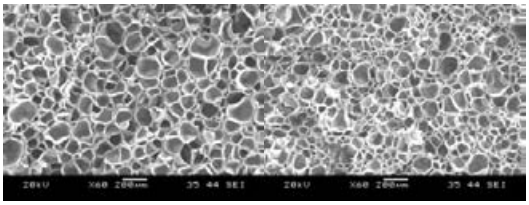
(a)



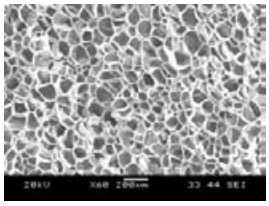
(b)



1phr 2phr

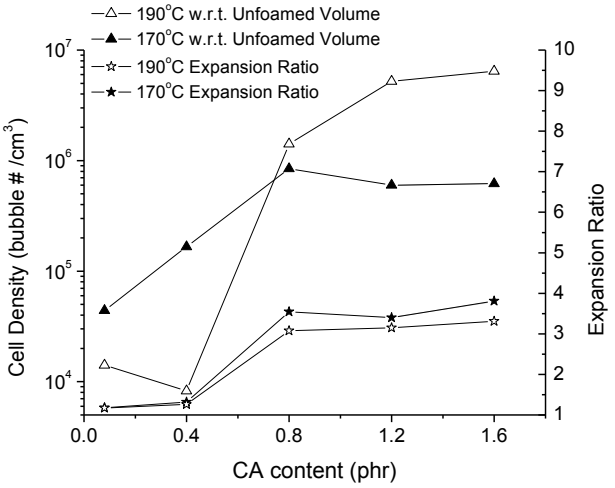


3phr 4phr

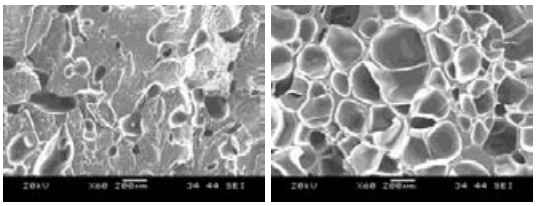


6phr

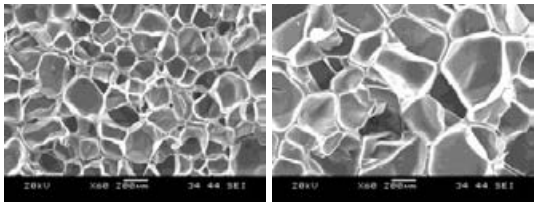
Figure 5 Crosslinked EVA foams with varying crosslinking agent contents (a) data graph (a) data graph (b) SEM imagines 170°C (c) SEM imagines 190°C



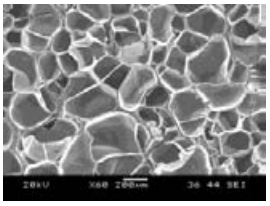
(b)



0.08phr 0.4phr

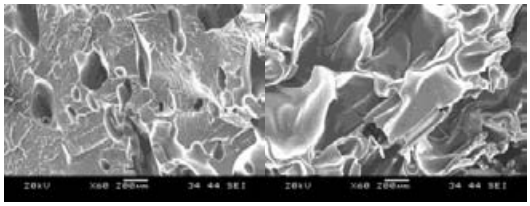


0.8phr 1.2phr

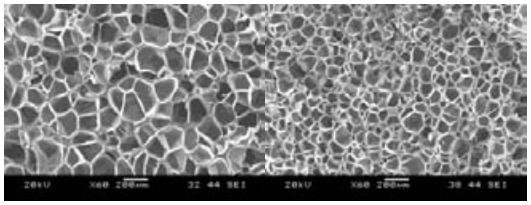


1.6phr

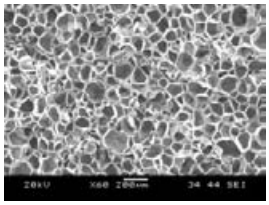
(c)



0.08phr 0.4phr



0.8phr 1.2phr



1.6phr

Figure 6. Schematic of cell model [22]

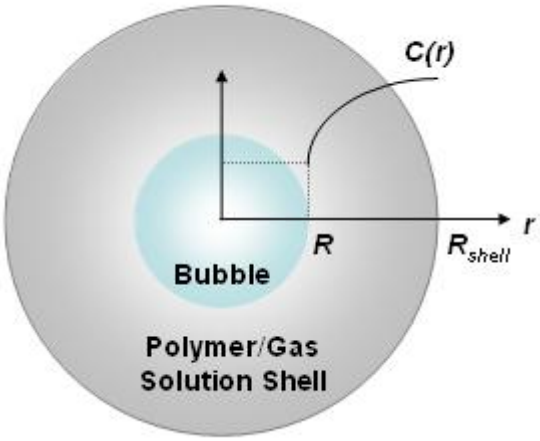
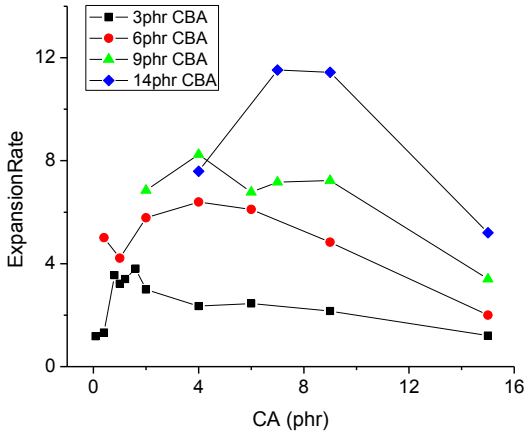


Figure 7. Optimization of maximum expansion ratio of crosslinked EVA (a) expansion ratio; (b) cell density
(a)



(b)

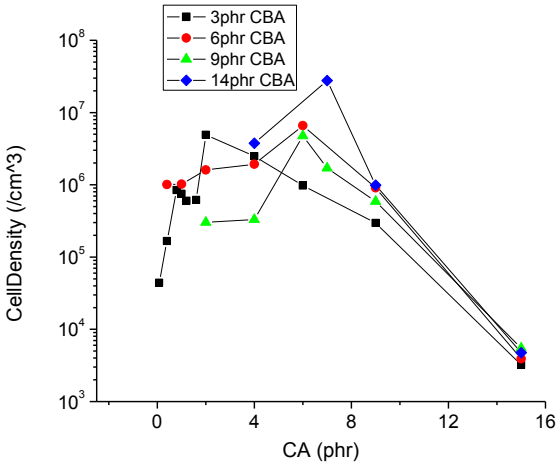


Figure 8. Curing percentage compared with fully crosslinked EVA (9phr DCP, 30min)

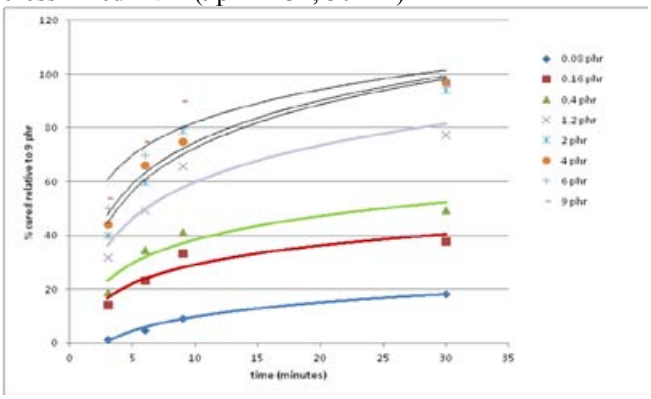
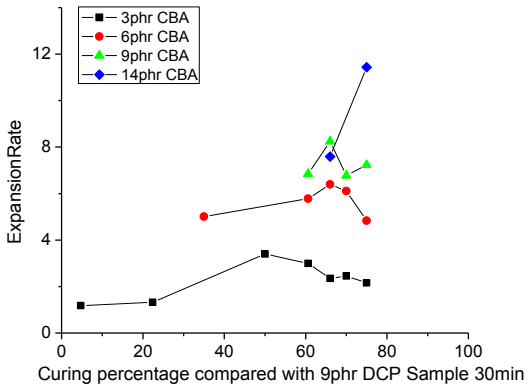
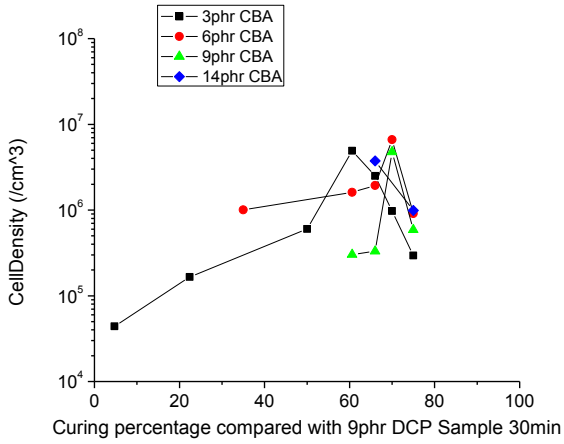


Figure 9. EVA foams with varying crosslinking percentage (a) expansion ratio; (b) cell density; (c) maximum expansion ratio along with CBA; (d) maximum expansion ratio along with curing percentage

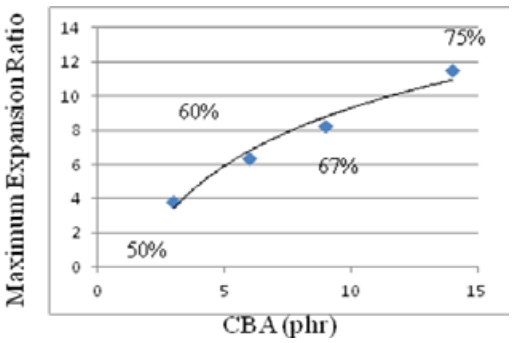
(a)



(b)



(c)



(d)