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FALL 2002 Issue

***Best Student Paper
Presentation
at ANTEC 2002***

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SIMULATION STUDY OF POLYMER FLOW THROUGH AN EXTRUSION BLOW MOLDING HEAD

by

Matthew J. Day

Penn State University, The Behrend College

James T. Haring

Penn State University, The Behrend College

Abstract

The unequal flow of polymer, through a die, is a common problem in industry. This imbalance in flow is due to a non-uniform flow path resulting in different velocities at different points in the die. This problem is commonly fixed by adjusting the die or pin position to compensate for the uneven flow. In complex die shapes, compensating for uneven flow cannot be done as easily. Simulation software was used in a verification study to ensure that the results from the software matched the experimental results. This will be useful in industry's determining of the validity of such software.

Introduction

The flow of a resin through an extrusion blow-molding die is complicated because the polymer must make a ninety-degree turn when forming the parison. In general, if a fluid of any sort changes direction, there are going to be gradient differences to a number of variables throughout the flow channel. This turn has led to significant problems with the output of the die, which are presently evident in industry. Some of the effects on the process are the differences in velocity and pressure of the parison tube.

A common way to solve the problem is to alter the die at the point where the melt exits to form the parison tube. When the die is geometrically centered, the flow problems exist at their peak, but adjusting the position of the die to allow for easier flow on a given side of the die can solve this problem.

This study will entail a computer-simulated model of the imbalances in the die, which can be backed up with physical data that will be gathered through material analysis.

Background

During the blow molding process the parison tube develops its geometry from the die head unit on the blow-molding machine. The die and mandrel can be engineered to alter the shape and thickness of the parison until the desired dimensions are obtained. The die and mandrel are the main components of the die assembly, controlling the parison formation. There are other components that give support and position to the die, such as the pressure ring and the clamp ring.

The mandrel, or pin, is the primary unit that controls the shape of the final parison. The geometry is usually a smooth surface that the polymer can flow over as a template, forming the correct inside diameter. The surfaces on the die and mandrel should be well polished and streamlined for the polymer to flow through. This surface finish will prevent stagnant areas of melt in the head unit.

The die surrounds the mandrel and forms the channel that the plastic will flow through. The difference between the die wall and the mandrel wall is usually about two degrees. The gap left at the bottom of the die and mandrel unit defines the thickness the parison tube will obtain (die gap).

Continued on Page 4

Chairperson's Message

Welcome to the Fall 2002 Newsletter

From Robert A. Slawska

Welcome to the SPE Blow Molding Division Fall Newsletter. We have just finished our latest Board of Directors Meeting on October 1, 2002, where we discussed the WEB site in great detail. I am pleased to advise that our SPE BM DIV Secretary, Mr. Ron Puvak of AGR*TOPWAVE has volunteered to be our WEB Master. We have made plans to keep this WEB site up to date with meaningful information to serve our SPE Blow Molding membership as well as the Blow Molding Market Place. Please pass on any information to Ron, which can be used on this site. Ron's email address is rpuvak@agrintl.com

The SPE Blow Molding Division has just held an extremely successful Conference on "INNOVATIONS IN BLOW MOLDING TECHNOLOGY". This was held at the Heritage Conference Center in York, PA. This conference was among the top 5 conferences held by the Blow Molding Division. Over 170 attendees were present as well as over 20 speakers on blow molding topics. The Graham Machinery Group was a major Sponsor for this Event. This included a tour of the new Graham Machinery Group facility as well as a demonstration of four blow molding machines producing products.

Mr. Donald C. Graham, Chairman of the Graham Companies was the Keynote Speaker at our Dinner.

We now have two newsletters available on the WEB site. These can be viewed directly via acrobat or downloaded to your files. We print the newsletter 3 times a year in spring, fall and winter. We welcome sponsors for these newsletters. Please contact Mr. Robert DeLong at robert.delong@bpsolvaype.com for details.

Dr. Lawrence Solin was awarded an Honorary Membership in the SPE Blow Molding Division for his continued contributions to the Carrie Fox Solin scholarship award each year. Mr. Tevor Beyeler received the award this year.

We wish to recognize the following corporate sponsors who have contributed to the education of Plastics oriented students:

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Our next major conference will be held October 14 and 15, 2003. This conference will be held in the Detroit area and will be Automotive oriented. Please mark your calendar and plan on attending this major conference on Automotive Blow Molding Technology. Blow molding of automotive parts are the largest area of our Technical Blow Molding Market. It is a must to attend and learn about the new, exciting happenings in blow molding parts, processing and equipment.

Thank you again for visiting with us. Please direct any questions or comments to me (RSlawska@aol.com) or any other member of the Board of Directors shown on the last page of our newsletter.

Sincerely,

**Robert A. Slawska
Chairman, SPE Blow Molding Division**

Blow Molding Calendar of Events

2003

January - ANTEC 2003 - Matrix Meeting

Nashville, TN - ANTEC 2003 TPC Chair & ANTEC 2004 TPC Chair to attend.

Jan. 29: SPE BM BOD Winter Meeting - Detroit, MI

May 4-8: ANTEC - Annual SPE Meeting & Conference, Nashville Convention Center & Stouffer Renaissance Hotel, Nashville, TN. John Meckley - Chairperson, Technical sessions, Blow Molding Division Board of Directors Meeting, No Business meeting, Best Paper, Scholarship & student design awards presented.

June 23-27: NPE 2003 - National Plastics Exhibition, McCormick Center, Chicago, IL

October 14th & 15th: SPE Blow Molding Division Annual Technical Program Conference (Automotive & After-market focus)

- Michigan State University, Troy, MI. Bob Jackson - Chairperson, Robert Dirrado is Co-Chair, Leann Starr - Local Coordinator. Technical Session, Formal business meeting & BOD Mtg., Lifetime Achievement awards presented.

EXCITING NEW APPROACH TO BLOW MOLDING NORMAN C. LEE SEMINARS/WORKSHOPS

To be successful in any endeavor we must change with the times. Certainly we are going through major changes in our industry today as a result of the current economic climate. With this in mind, we are trying different approaches to our Blow Molding Seminar/Workshop programs without discarding elements, which have proved successful in the past.

A new wrinkle we are exploring is to make available the Preprogram (for those relatively new to Blow Molding) as a 'Virtual' presentation live on the Internet in the week before the Workshop for those who sign up for the Workshop and a small fee for others who wish to participate in the presentation only.

The preprogram has been necessary in the past because several participants had very little exposure to the Blow molding process and thus needed to be exposed to Blow Molding fundamentals which was redundant to most attendee's. Also in the past we have held these either on the afternoon proceeding the main sessions or on the morning before the first session.

We will hold the following:

Industrial & Large Part Blow Molding Workshop

Featuring: Problems & Solutions

Date: March 24, 25 & 26, 2003

**At: Equistar Chemicals (11530 Northlawn Drive, Cincinnati, OH)
& Milacron Facilities (4165 Halfacre Road, Batavia, OH)**

At this workshop you will examine how to: Lower costs & increase efficiency with design mold engineering, material selection and machine utilization. Features "Hands On" practical know how from concept to production. **Information on Workshop** Contact by phone: Call SPE at 203-740-5403 or online: go to <http://www.4spe.org/conferenceseminar.htm>, then go to upcoming seminars, then go to the title of program of interest.

In the fall High Production Blow Molding will be held in York, Pa where Graham Engineering will be host. A new location for us, but one where your Division held a successful conference last year.

At NPE, being held in Chicago, June 23-27, a new Seminar 'Success in Blow Molding (quality parts, ontime, on cost, on budget)' will be presented on Wednesday and Thursday of the show, as part of the SPE Seminar program, with leaders of our industry participating. A must for those interested in increasing their machine "up time", thereby improving scheduling and inventory and thus their bottom line.

The support of the Blow Molding Division Board of Directors and members has been essential to the success of the SPE Seminar/Workshop programs in the past. This is much appreciated and has been to our mutual benefit, as we look forward to your continued efforts and move positively to the future Directors and members.

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**Any of the Board of Directors
listed on the back of
the Newsletter**

**Large Part
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Milacron Facilities,
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Workshop Leader:
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(see further details in this newsletter)

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SIMULATION STUDY OF POLYMER FLOW THROUGH AN EXTRUSION BLOW MOLDING HEAD

Continued from cover

The die gap may be adjusted by moving either the die or mandrel up and down to control the thickness of the parison tube. This adjustment is referred to as parison programming and can be accomplished by a hydraulic cylinder. This technology is used, in industry, to control the thickness of the part wall when areas of varied wall thickness arise such as corners. The process can control the thickness of the parison wall, but does not account for the imbalances from a mandrel that is not correctly centered inside the die. To use parison programming at its fullest potential, the mandrel should be geometrically centered in the die to ensure an assumed constant wall thickness.

The clamping ring is attached to the outside of the die to center the die around the mandrel. There are four threaded bolts spaced equally along the circumference of the ring that thread through and apply pressure to the die. These bolts can then be adjusted at any time during production to obtain a balanced flow channel. Even though the flow channel may be balanced with hardware, there are imbalances that can occur from pressure and velocity differences in the die unit, specifically the head.

Although there are different types of heads in use today, for our research we will be using a side feed head and a PVC head. The head changes the flow of the melt from a horizontal flow to a vertical flow in a relatively short distance. The head design plays a vital role in the formation of the parison tube. If designed incorrectly, problems can occur such as weld lines and streaking. The quality of the head design may be directly linked with the quality of the parts formed.

A phenomenon that appears in extrusion blow molding is the imbalance of the output of plastic from the rear of the die to the front. This occurs because of the path the melt takes when traveling through the head unit. The changing of a fluid's velocity, in any direction, leads to pressure and velocity gradients. In this case, the imbalance can be directly traced to the distance variances throughout the process. The melt that is on the inside of the 90-degree turn has less distance to travel compared to the melt that is on the outside of the turn. When this fluid travels a longer distance, it is more apt to a higher pressure drop, which will slow the flow rate. This developed velocity gradient, is seen in the unequal output from the die gap. The output is usually corrected by altering the die, so that the mandrel is not geometrically centered.

There are other ways to correct this problem. The die head formation can be designed to swallow any imbalances by using chokes and die pools. Some dies have techniques like partial wall thickness distribution systems

Equipment

The Bekum 402S is a continuous extruding, extrusion blow molding machine. The Bekum BKD 60B Head is the die mounted in the Bekum 402S. The special cutter, as pictured in Figure 1, is a device attached to the bottom of the die. It is geometrically centered and cuts the melt into 4 sections.

The dies, mandrels, and melt surfaces are modeled in Pro Engineer. The meshing, process set-up, and running takes place in Polyflow.

Simulation Procedure

First, a die and core assembly is modeled in Pro Engineer. The assembly is used to model the shape of the melt through that assembly. The shape of the melt is modeled using surfaces. Then, that surface model is exported as an IGES file. The IGES file is, then, read into Polyflow modeling program. Next, the processing parameters are set as seen in industry.

Polyflow was run using a Bird Carreau Generalized Newtonian viscosity model. The program will compute the results. Finally, the results are reviewed and entered into a spreadsheet. The results of the four dies are compared.

Procedure for Actual Results

The die and pin are disassembled. After measuring the die and pin for modeling purposes, the die and pin are reassembled into the machine. Next, the die is geometrically centered by turning the die adjusting screws on the clamping ring until the opening is equal around the die. Then, the heats are turned on and the machine is allowed to soak for 4 hours, so the machine components can reach equilibrium. The die is rechecked for geometric balance. The extruder is started and the heats and screw rpm's are allowed

to stabilize. Then, five samples of the melt in 30 second increments are taken and placed on paper plate. The samples are weighed. Finally, the special cutter is attached to the bottom of the die. Five samples of the melt in 30 second increments are taken for each quadrant from the special cutter. These samples are weighed, as well. The procedure is repeated for 2 other rpm's. All data is entered into a spreadsheet. The data is analyzed and compared with computer results.

Discussion of Simulation Results

For a comparison of results, several dies were modeled for analyses. There were converging units and diverging units. The converging dies were modeled as side feeds. One of the converging dies was modeled with a die pool. The die pool was added to simulate a die with a correction for the flow imbalance designed into the hardware. A diverging die was modeled for a side feed and the other was modeled for a PVC head.

Polyflow showed an imbalance in the flow for all the dies modeled, favoring the inlet side of the die. The effects of the imbalance cause the extruded parison to sway away from the inlet side of the die.

As seen in Figure 3, this diverging unit was modeled as a side feed unit. The melt enters the head unit and flows down the die and mandrel, but also has to flow around the mandrel itself. The shortened unit magnifies the effects and shows a clear velocity difference at the exit of the die

A plot of the velocity gradient shows a fast velocity at the inlet and then tapers down to a slower flow as the melt fills the volume of the flow channel. The velocity at any point where there is contact with a metal surface has a velocity of zero. As the material flows through the die some of it becomes lodged along the surface due to friction. However, once a critical shear stress is generated, the lodged material will slide because of velocity and pressure.

A plot of the pressure gradient will show the melt being forced down and around the die. This is pictured in figure 4. In order for there to be a balanced flow, the pressure gradient must be near zero by the time the melt exits.

Continued on Page 5

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As the plastic flows around the ninety-degree turn, the melt takes the shortest path determined by flow length. Due to the flow rate, the melt is forced around the mandrel piece as the pressure increases. The area directly across from the inlet on the opposite side of the mandrel shows no flow. There is a difference in velocity between input and output due to a difference in cross sectional areas. The melt velocity is higher at the inlet, but the volumetric flow rate is equal between the inlet and outlet.

An increase in pressure is directly related to an increase in velocity. It can be assumed that the difference in velocity has a direct relation to the flow length. With this pressure build up, and varying flow length, an increase in velocity is expected to be seen in the simulation as well as in actual data collection. With this process understood, mandrels can be designed with a die pool tooled in. This die pool can reduce the pressure gradient across the die head by collecting a pool of melt, balancing the uneven flow characteristics.

The next step was to analyze the effect a die pool would have with computer simulation. The same converging die model was used with a slot representing the die pool added into the geometry. It was expected that the analysis would show a balanced output of the parison. Figure 2 shows the velocity plots of the entire modeled die with the die pool. The die pool had a great effect in balancing the flow, however did not balance it completely. The die pool works well to balance the velocity gradient by opening a channel where the melt would be more inclined to flow around the die instead of down.

Discussion of Actual Results

The actual results are represented in Figure 5. The graph is composed of 4 quadrants representing the average weight in grams of the collected samples. Each of the quadrants corresponds with a location on the die. Quadrants 3 and 4 are located on the inlet side of the die and quadrants 1 and 2 are on the opposite side of the die from the inlet.

The melt from quadrants 3 and 4 weighed about 30 grams more than the melt from quadrants 1 and 2. This shows that more melt was exiting on the inlet side of the die.

Conclusion

It is evident that the extrusion software can show flow imbalances in a die head formation. This technology can be utilized to aid in the design of better dies and mandrels to obtain a balanced flow. Future studies should be done to discover the effects of melt temperature and shear on the simulation model.

Acknowledgements

We would like to thank Jonathan Meckley for his assistance in writing this paper.

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
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Board of Director's Meeting

Minutes of the Board of Directors of the Blow Molding Division of SPE,
Meeting held at San Francisco Marriott, Yerba Buena Salon 10,
San Francisco, CA - May 5th, 2002

- **Executive Meeting: Present - Mark Heitker, Bruce Thompson, Bob Slawska, Charlie Keener, Ron Puvak - Meeting Called to Order at 1:09 PM**

> Bob DeLong accepted position as Finance Director.

Action Items:

1. *Executive committee to define a policy for when the board will have a teleconference and when we have a face to face meeting. Policy to be ready for next BOD meeting review.*

Board of Director's Meeting

- **Call to order**
- > Bob Slawska called to order at 1:55 PM
- > Some recognition: Don Peters acknowledged attending as an active member.
- > Eric Skov has resigned. Position will remain open temporarily as replacements are reviewed.
- **Secretary's Report by Ron Puvak**
- > No changes or corrections
- > Motion to approve made by Bruce Thompson, Seconded by Bob Jackson, and Approved by all.
- **Treasurer's Report by Mark Heitker**
- > Report distributed, No changes made
- > Motion to approve made by Mark Heitker, Seconded by Joe Altimari, and Approved by all.
- > Motion made by Gary Henneberry that any money collected on behalf of the newsletter sponsorship that is unused in a fiscal year be moved to the prudent reserve for the next fiscal year, Seconded by Bob Jackson, Approved by all.
- **Finance Report by Gary Henneberry**
- > Change made to add \$1500 to 2003 conference money; Bob Jackson motioned, Seconded by Warren Bentkover, Approved by all.
- > Change J. Raymond scholarship to \$3000.
- > Bruce Thompson would like to change education student travel from \$500 to \$1500. Instead line item would be to add \$1000 for scholarship travel reimbursement.
- > Motion to pass disbursement account by Gary Henneberry, Seconded by Bruce Thompson, and Approved by all.
- **Nominating Committee Report by Bob Gilbert - given by Bob Slawska**
- > Voting completed; slate #2 filed
- > Need to add people to nominating committee
- **Awards Report by Dave Holliman**
- > Lifetime Achievement Award - Bob Slawska
- > Outstanding Board Member for 2002 - Ron Puvak and Bob Gilbert
- **Membership Report by Bob Slawska**
- > Lew Ferguson will be new membership chairman
- **Publicity / Web Site Report by Bob Jackson**
- > Budget is ok for this year.
- **Councilor's Report by Charlie Keener**
- **Newsletter Report by Bob Slawska**
- > Need new sponsors; Bob is working on deals for sponsorship

Action Items:

1. *Bob DeLong & Cheryl Hayek to propose possible overall sponsorship directions and packages*
- **TPC - Mark Heitker**

TPC - SUB-COMMITTEES/ACTIVITIES

1. **ANTEC 2002 Report - Ron Puvak**
1. Could have up to 3800 people; 1600-1800 paid - this includes partial and full conference.
2. Will generate review letter for Mike Cappaletti to discuss changes to ANTEC.
- > **ABC 2002, York PA - Joe Altimari**
1. Motion for \$1500 additional seed money made by Mark Heitker, Seconded by Gary Henneberry
- > **ANTEC 2003 Report - John Meckley**
1. No report.
- > **ABC 2003, Detroit MI - Bob Jackson**
1. OK, all issues discussed at TPC meeting; Oct 14 & 15, 2003, Troy MI, at MSU campus.
- > **ABC 2004 - Bob Dirrado at the NRC.**
1. Detailed report to be generated later.
- > **ABC 2005 - TBD**
1. Several ideas posed, PSU Behrends; Toledo, OH; Cincinnati area
- Move to accept TPC report by Cheryl Hayek, Seconded by Bob Dirrado, and Approved by all.

Continued on Page 10

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Engineer vs. Manager

A man is flying in a hot air balloon and realizes he is lost. He reduces height and spots a man down below. He lowers the balloon further and shouts: "Excuse me, can you tell me where I am?"

The man below says: "Yes, you're in a hot air balloon, hovering 30 feet above this field."

"You must be an engineer" says the balloonist.

"I am" replies the man. "How did you know?"

"Well," says the balloonist, "everything you have told me is technically correct, but it's no use to anyone."

The man below says "you must be in management."

"I am" replies the balloonist, "but how did you know?"

"Well," says the man, "you don't know where you are, or where you're going, but you expect me to be able to help. You're in the same position you were before we met, but now it's my fault."

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A Message from Joe Altamari, Chairperson of the SPE Blow Molding Division "Innovations In Blow Molding Technology" ABC 2002 Conference

It was my privilege and honor to serve as chairperson for this year's Annual Blow Molding Conference. It was held at the Heritage Hills Golf Resort and Conference Center in York, PA. This allowed for Graham Machinery Group to be a most gracious host and sponsor. The highlight of the proceedings was a tour of the Graham factory. The attendees had the opportunity to see Continuous Wheels, double-sided shuttles presses, and an accumulator head machine making color changes in 30 minutes.

There were over 175 participants from all over North America, Europe, and even Asia. The turnout was exceptional and gives a prospect of hope that our industry is finally coming out of the financial downturn that it is currently experiencing.

The presentations were insightful and informative. We were very careful in the selection of the topics so that we would achieve a balance between industrial and bottle applications. The role of this division is to give equal time to all aspects of blow molding.

Many of the talks covered topics regarding new resins, applications, automation, and advanced auxiliary equipment. Almost every major supplier of blow molding machinery was in attendance and gave presentations.

Various companies purchased tabletop exhibits in an effort to reach all of the attendees. Many commented on the level of the conference participants and hopefully some new sales will come from these initial contacts.

The first day's events concluded with a dinner at the Heritage Hills Conference center. A lifetime achievement award was given to Bob Slawski, as well as our division's annual Scholarship recipient, followed by a keynote speech by Don Graham, Chairman of the Graham Companies. Don shared with everyone his insights into what the future will hold for our industry.

A special award for the best presentation went to Ralph Armstrong of Owens-Illinois Food and Beverage Products for his paper on Barrier/ Multilayer Developments. It should also be noted that Wheaton USA topped the participant's list with 12 attendees.

continued on the next page

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A special note of thanks needs to go to Cheryl Hayek and Ron Puvak, both fellow Board of Directors and my Co-Chairpersons, as well as Shelia Furrh, Emma Griffith and Bob Slawska. Additional thanks should also go to Shannon Swartz, Wendy Gohn, and Sharon Knox of Graham Engineering who coordinated the tour of GMG and the conference facilities.

Looking ahead to next year's conference, please plan on attending in Detroit, MI. We will be posting information on this in our newsletter and website as it becomes available.

**PHOTOS FROM
INNOVATIONS IN BLOW MOLDING TECHNOLOGY CONFERENCE**



Steve Wood, Chairman of Graham Machinery Group receiving a plaque from Bob Slawska, Chairperson of SPE Blow Molding Division for Graham being the Major Sponsor of the Conference



Donald Graham, Chairman of Graham Companies, Keynote Speaker



Trip Thomas of Wheaton (front left) and Wheaton Folks at Conference



Joe Altimari, Chairman of Innovations in Blow Molding Technology Conference (at podium) introducing Conference



Attendees at the Innovations in Blow Molding Technology Conference



Dr. Larry Solin (left) receiving an Honorary Lifetime Blow Molding Division Member Award from Mark Barger, Education Chairperson

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Board of Director's Meeting *continued from Page 6*

- **Education - Mark Barger**
- > Report e-mailed; 9 applicants for Solin scholarship received.
- > 2002 recipient is Trevor Beyeler – Pittsburg State.
- > Dr. Solin will give scholarship at ABC in October.
- > Trevor will be an honored guest at ABC – no cost.

Action Items:

1. Mark will generate a plaque through Dave Holliman
2. Mark Barger motioned to have Dr. Solin. as a Blowmolding Lifetime member, Seconded by Bruce Thompson, Approved by all.

- **Marketing - Warren Bentkover**

- > Motion made by Bob Dirardo to approve marketing letter, Seconded by Dave Holliman, Approved by all.

Action Items:

1. Ron Puvak & Warren Bentkover will draft brochure about SPE Blowmolding activities/benefits by ABC 2002

OLD BUSINESS:

1. Bruce suggested new Board Member packet – Bruce Thompson will prepare this as function of Chair-Elect duties – **Will use up to date SPE brochure.**
2. Shirt program to be continued for first time elected/appointed BOD members – motion by Bruce Thompson; second by Bob Gilbert – Mark Heitker will contact Bob DeLong – **OK Completed**
3. Blowmolding division policy manual needs to be reviewed. We will begin with 5 pages at a time. Bruce Thompson will take all revisions. – **Ongoing**

NEW BUSINESS:

1. Director attendance requirements read by Bruce Thompson; issue of meetings attendance via teleconference will be discussed at ABC meeting; Executive Committee to propose a policy for the meeting.
2. E-mails: response by BOD members is minimal and needs better response; suggest that by lines be "require a response & be sent to all BOD members".
3. Bob Dirardo suggested best paper award to be named "Andres Garcon-Rejon Best Paper Award". Instead, an action item for the awards committee to determine the proper recognition. Have the proposal ready by the ABC.
4. Michael Cappaletti gave brief overview of future of SPE and the divisions. Answered questions on programs and other activities. He was responsive to the issues and challenged the board to send their wishes onto him so that he can take it to council.

Action Items:

1. Awards committee to propose recognition for Andres Rejon-Gracia and others.
2. Continue to Update policy manual pages.

ADJOURNMENT:

6:00 pm: Motion to adjourn made by Bob Jackson, Seconded by Bob DeLong

Meet John Rathman, Our Newest Member of the SPE Blow Molding Division Board of Directors



John Rathman

John Rathman is the most recent person to become a Member of the SPE Blow Molding Division Board of Directors. John is an employee of Chevron Phillips Chemical Company (formerly Phillips Chemical Company) from 1976 to present (26 years). At the present time John is specializing in Blow Molding Technical Service in HDPE with specific areas of expertise in large part blow molding and injection blow moldings.

John has a Bachelors Degree in Chemical Engineering from the University of Nebraska. He is a member of the Society of Plastics Engineers; Local Chapter Positions included: Past Vice-President, Past President, and Currently Councilor. He is currently the President American Institute of Chemical Engineers.

John enjoys being with his family, gardening and traveling.

SIMULATION STUDY OF POLYMER FLOW THROUGH AN EXTRUSION BLOW MOLDING HEAD

continued from Page 5

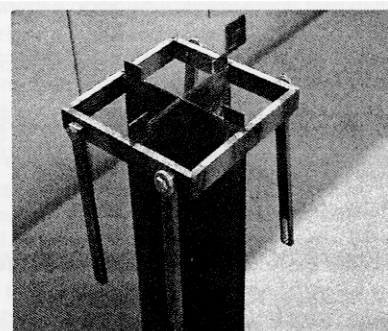


Figure 1

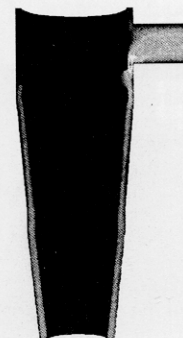


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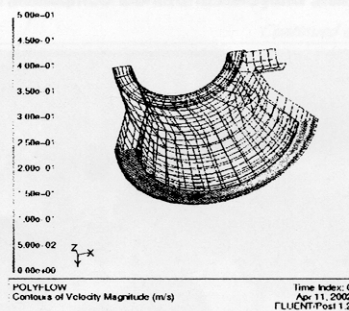


Figure 3

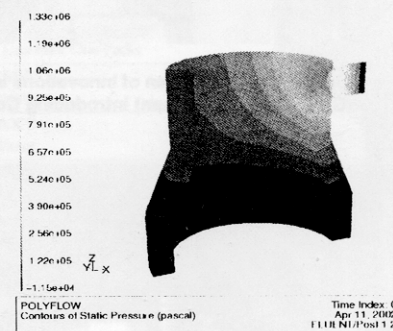


Figure 4

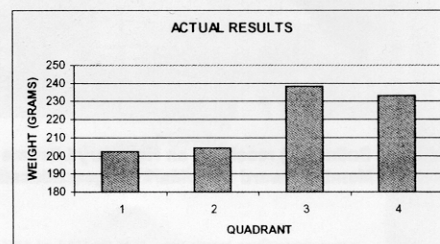


Figure 5

**PHOTOS FROM
INNOVATIONS IN BLOW MOLDING TECHNOLOGY CONFERENCE**



Dr. Larry Solin presenting Trevor Beyeler with The 2002 Carrie Fox Solin Scholarship Award from the SPE Blow Molding Division



Robert A. Slawska - 2002 Lifetime Achievement Award Winner with Willi Muller - 2000 Lifetime Achievement Award Winner



Trevor Beyeler - The 2002 Carrie Fox Solin Scholarship Award Recipient with his wife



Chevron Phillips Group at the Conference Dinner

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