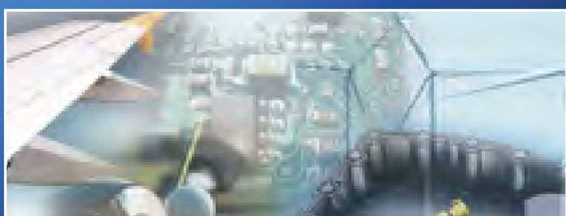
COMPOSITES

DECEMBER 2017 / JANUARY 2018



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In All Industries

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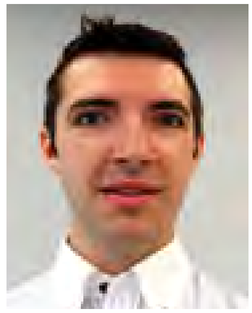

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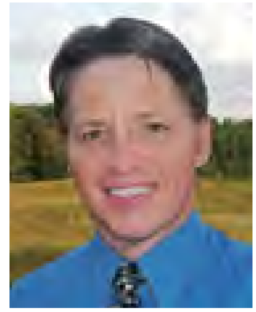

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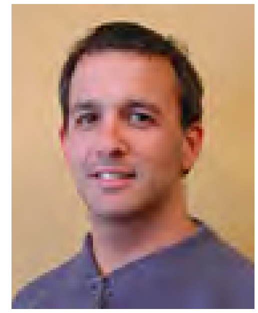

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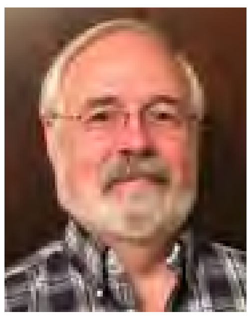

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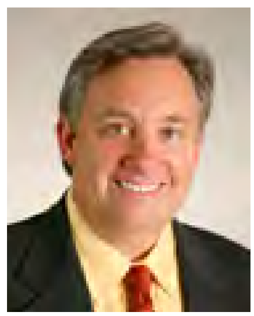

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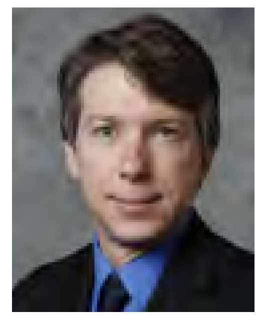

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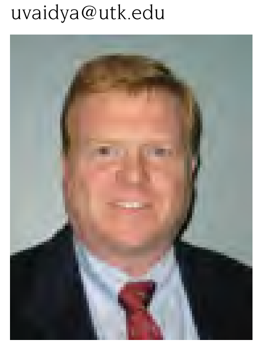

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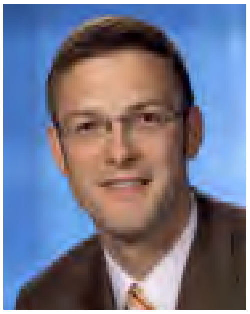

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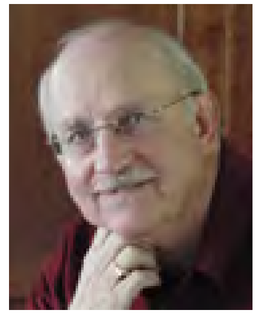

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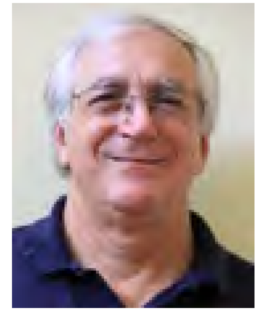

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- BOD Listings
- BOD Meeting Minutes
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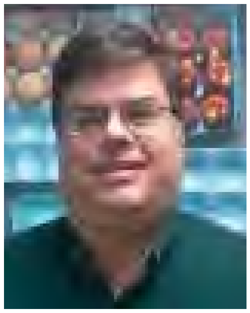

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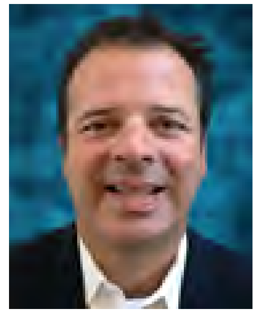

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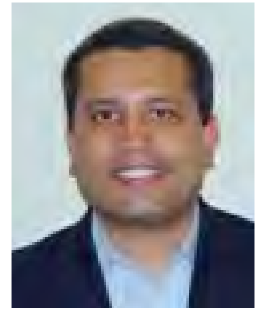

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Board Meeting Minutes July 24, 2017

By: Antoine Rios

Conference Call
Monday, July 24, 2017

Attendees:

Michael Connolly
Dale Brosius
Steve Bassetti
Jim Griffing
Mingfu Zhang
Christoph Kuhn
Pritam Das
Andy Rich
Dan Buckley
Fred Deans
Rich Caruso
Dale Grove
Ray Boeman
Ian Swentek
Antoine Rios
Hicham Ghossein
Enamul Haque
Nippani Rao
Jack Gillespie
Tim Johnson
John Busel
Dan Houston

Meeting started at 12:04 pm EST

Chair: Ray Boeman

- Elected officers we announced at the last Antec meeting:
  - Ian Swentek – Chair-Elect
  - Dale Brosius - Councilor
- The board is looking for volunteers to lead the communications and membership committees.
- J. Busel volunteered to help with membership committee.
- **Action (All):** let Ray know if anyone is interested in volunteering in these committees.
- Report on status of manual and SOP

continued on page 8...

Minutes continued...

- **Action (MC):** Send out final version for review and vote.
- **Action (MC):** Compile and sent to Ray.

Secretary: Antoine Rios

- Last meeting minutes (Antec)
- **Action (ARios)**: complete and distribute for approval
- Status of elections to board of directors.
- Email from SPE went out last week. Voting under way.

Communications: Andy Rich

- Met with Pedro Matos from SPE to brainstorm and understand how SPE managed microsite works.
- Improvements were made within the limitations of the microsite template.
- If more contents than what the microsite allows is desired, we will need to host a domain outside of SPE's domain.
- The sponsorship banner is up. Andy is now working on making sure that sponsors and logo get updated.
- **Action (ARich):** The Harold Giles award announcement needs to be posted.
- The old website address will be directed to the new website within SPE. We will maintain URLs.

Councilor Report: Creig Bowland/Dale Brosius

Council meeting report provided.

Treasury Report: Tim Johnson

- Report provided
- The financial year has closed. The division had more inflows than outflows.
- Next year's budget will roll over last year's plus any modifications.
- **Action (TJ):** put proposal together for executive committee to diversify fund where excess cash resides.

Awards: Ian Swentek

- Continue working on HSM application for Uday.
- Continue working on Fellow application for Jack Gillespie.
- We did not receive many applicants for ACCE scholarships.
- **Action (IS):** develop recommendations to revise state and process of awards.

continued on page 9...

Board Meeting Minutes continued...

Education: Ray Boeman in behalf of Uday Vaidya

- Report provided.
- 23 student posters have applied so far for ACCE. We expect about 40.
- Amount paid to each student comes out of ACCE funds.
- Intention to have a conference call for the university equipment fund.

Technical Conference Report:

- ACCE 2017 (September 5-8, 2017, Novi, MI) – ***Dale Brosius /Michael Connolly***
- Sponsorship for this year holding well. Close to last year's numbers.
- Number of papers so far about average compared to previous years.
- Need to speed up reviews.
- A tour is being planned of IACMI Vehicle Technology Area Corktown facility.
- COMDIV BOD meeting is being planned at ACCE venue.

- SPE/JEC Composites for Performance in Sports (Jan 23-24, Long Beach CA) – ***Rich Caruso***
- Rich Caruso will become the contact person for Craig Bowland. JEC had Craig as contact so Rich was not aware of all what was going on.
- List of potential sponsors and speakers to be shared by JEC.

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Board Meeting Minutes continued...

- Thermosets 2018 (February 20-21, 2018, Indianapolis, IN) – ***Dale Brosius***
- Had conversation with Len Nunnery about venue.
- There is commitment to drive papers and sponsorship.
- There will be a financial commitment making it a joint venture conference.
- More details will be available by ACCE meeting.
- John Busel volunteered to help.

- ANTEC/NPE 2018 (May 7-10, 2018, Orlando, FL) – ***Jim G./Shankar S./Rich C.***
- Final report sent.
- List of no shows was sent to Shankar and Rich Caruso.
- There is a proposal to conduct awards after one of the sessions.
- John Busel volunteered to help.

Inter/Intra-Society: John Busel

- Four presentations from SPE Composites throughout conference. This year there won't be a SPE only session.
- CAMX 2018 will be in Dallas in October.

Newsletter: Pritam Das

- Received information needed from board for newsletter.
- The board approved expenses to have a bag at ACCE with COMDIV logo.

Meeting adjourned at 1:34 pm EST

Next Generation Advisory Board

Generating Leaders for the Society of Plastics Engineers

You may have caught the article about SPE's Next Generation Advisory Board (NGAB) in the September issue of Plastics Engineering Magazine. If not, we are a group of young professionals and students who are focused on laying the future foundation for SPE and creating tomorrow's industry leaders.

Over the course of the past four years, NGAB has managed to grow from three members to a strong collective of 67. We hold monthly calls and plan activities for increased young professional engagement in SPE.

This year, we have begun to partner with Sections & Divisions to plan NGAB activities that are co-located with TopCons and other industry events, such as IMTECH and the Annual Blow Molding conference. These events have been effective in engaging the next generation of plastics professionals and have helped us strengthen and grow our core team.

If you are interested in joining NGAB, or partnering with us to for an event, please contact Mercedes Landazuri mlandazuri@apexcolors.com or Shankar Srinivasan srigshan@iastate.edu to learn more. You can also follow us on Facebook at www.facebook.com/NextGenAdvisoryBoard/

Best,
Mercedes Landazuri
Chair, SPE Next Generation Advisory Board
Customer Relations, Apex Colors, Inc.

Photo in banner above from The Plastics Race at ANTEC 2015.
Photos below from NGAB meeting at IMTECH, NGAB Cookout & Volleyball at IMTECH, NGAB Whirlyball Social at Annual Blow Molding Conference.

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Bioplastics
Blow Molding
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Composites
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Extrusion
Failure Analysis & Prevention
Flexible Packaging
Injection Molding
Joining of Plastics & Composites
Medical Plastics
Mold Technologies
Plastic Pipe & Fittings
Sustainability
Plastics in Building & Construction
Polymer Analysis
Polymer Modifiers & Additives
Product Design & Development
Reaction Injection Molders
Rotational Molding
Thermoforming
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Thermoplastic Materials & Fomas
Thermoset
Vinyl Plastics

Paper and Technical Marketing Presentation Deadline: December 4, 2017

Questions?

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ANTEC® Orlando 2018

Award Winning Paper

End to End Process Simulation of the High Pressure Resin Transfer Molding Process

Nathan Sharp, Johnathan Goodsell, Byron Pipes
Composites Manufacturing and Simulation Center, Purdue University

Abstract

An end-to-end process simulation has been created to predict the high pressure resin transfer molding (HP-RTM) process. Material properties such as fiber orientations and resin properties are mapped throughout the process so that a performance model can be run on a part as it is actually manufactured, not just as it is designed. A B-Pillar geometry was used as a demonstration part and showed a difference in residual deformation of almost 20% when the as-manufactured material properties were considered.

Introduction

While carbon fiber reinforced polymers (CFRPs) are often considered materials, in actuality they are structures. The fiber architecture within a CFRP is largely what determines its properties. Because there are too many fibers to model explicitly, homogenization techniques are used to get properties of the CFRP treating it as if it were a homogeneous material. These techniques work well as long as the assumed microstructure that is used to homogenize is accurate. However, if

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Award Winning Paper continued...

the microstructure is significantly different from the assumed microstructure, the estimated laminate properties can have large errors1. This can be problematic for designers of CFRP parts because many manufacturing processes cause the microstructure to change. If these changes are not taken into account, designers may be designing based on properties which can in actuality never be achieved in a real part because the assumed microstructure cannot realistically be made. In order for a performance model to have accurate predictions, an end-to-end manufacturing process model must first be run so that the performance analysis considers the as-manufactured part, properties and state. This is called “manufacturing-informed performance simulation.”

The HP-RTM manufacturing process includes 6 main steps, shown below in figure 1. The starting point is a roll of carbon or glass fiber fabric. The next step is to cut the fabric into the flat shapes necessary to make the desired part geometry. The cut fabric is stacked and assembled into a fiber mat and placed into a two-sided mold. The mold is then compressed so the fiber mat conforms to the desired geometry. At this point resin is infused at high temperatures and pressures so that it infuses through the preform very quickly. The mold remains at high pressures and temperatures for a time to allow the resin to completely cure, at which point the

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mold is opened and the part is cooled and removed. The physical phenomena associated with the last four process steps as well as their influence on the design process are outlined in figure 2.

Virtual Manufacturing Process

The manufacturing process steps outlined previously are simulated with analogous virtual steps. The draping step is modeled in order to predict the fiber directions and shearing strains that result from draping a fabric over a complex geometry. Since composite material properties are dominated by fiber direction, this result will affect all subsequent steps. The infusion and cure steps are modeled together because the physics behind the two steps are coupled together with infusion speeds being a function of degree of cure and both steps being a function

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Figure 1: HP-RTM *process flow diagram*.

PREFORMING	RESIN INFUSION	HEATED CURE	DEMOLDING
Fabric shearing and deformation Determines tow/fiber orientation Affects modulus, strength, warpage	Darcy Flow Determines impregnation Affects consolidation and warpage	Cure Kinetics Determines polymer properties Affects internal stresses and warpage	Residual Stresses & Deformations Determines final part shape Affects strength and tolerances
Tooling-preform interaction can cause excessive shearing & wrinkling	Improper gating/venting/pressure can cause incomplete fill or washout	Incomplete cure reduces polymer properties	Improper tooling can yield out-of-tolerance geometric deviations

Figure 2: *Physical phenomena associated with* HP-RTM *process steps*.

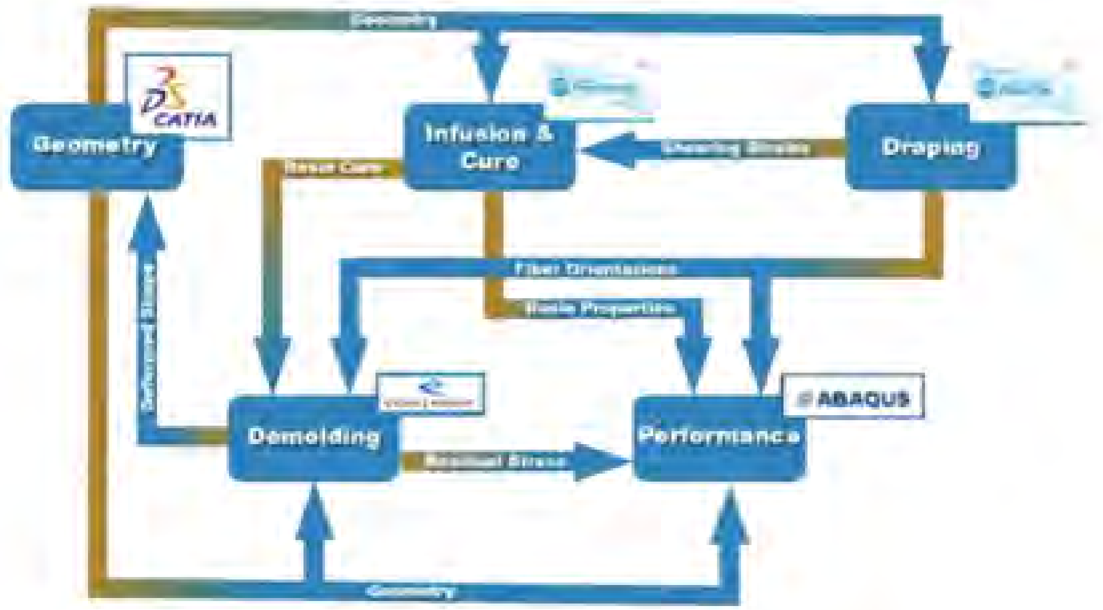

Figure 3: Virtual manufacturing flow diagram.

of temperature, which is often not isothermal for HP-RTM. The demolding step will import fiber direction, temperature, and curing behavior to aid in the prediction of the part warpage and residual stress state. All of the manufacturing effects are then brought into the performance model so that the effective properties, residual stress state, and final shape of the manufactured part can all be included into the performance analysis. Figure 3 shows a flow diagram of the virtual manufacturing process described above.

Demonstration Part Geometry

In order to demonstrate the virtual manufacturing process, a part must be selected to perform the process on. An automotive B-Pillar was selected as the demonstration part, shown in figure 3. A Hexcel IM7 carbon twill fabric was selected with the properties as shown in table 1. The part consists of 4 plies of the twill fabric. The fabric is laid down with a 0/90 fabric followed by two ±45 layers of fabric and another 0/90 fabric on top. The 0 degree direction is along the x direction as shown in Figure 4.

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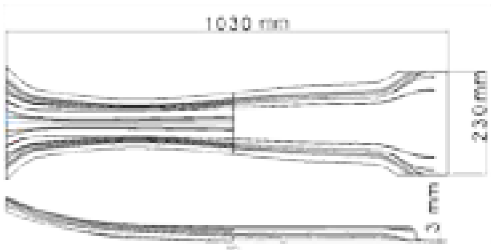

Figure 4: B-Pillar part dimensions.

Physical Phenomena

The physics behind all of the HP-RTM steps identified in figure 2 are well known and can be modeled using commercially available software packages. We will briefly discuss the physics behind each virtual step; a more complete description of the modeling techniques of each step can be found in documentation of the software packages used in each virtual step.

Parameter	Value
Fiber modulus (GPa)	276
Bending stiffnes (N/mm)	60
Aerial weight (g/m^2)	300
Permeability (m^2)	1e-11

Table 1: Carbon twill fabric properties.

Draping

Since composite fabrics experience a large rigid body rotation and small strain during draping process, the analysis of draping process is typically a geometrically nonlinear problem. By ignoring the body force, the variational weak form of the governing equation can be expressed in the reference configuration by[2]:

$$\int_{\Omega} \rho \ddot{u}_i \delta u_i \, d\Omega + \int_{\Omega} S_{ij} \, \delta E_{ij} \, d\Omega - \int_{\Gamma} t_i \delta u_i \, d\Gamma = 0 \quad (1)$$

where Ω and Γ are the volume of the undeformed fabric and the boundary surface of the deformed fabric, respectively; ρ is the mass density; u_i designates the vector of displace-

continued on page 20...

ment and rotation; $\ddot{u}_i$ represents the acceleration; t_i is the surface traction vector initially applied on Γ; S_{ij} and E_{ij} are respectively the second Piola-Kirchhoff stress tensor (PK2) and Green-Lagrange strain tensor which are given by:

$$S_{ij} = J \frac{\partial X_i}{\partial x_k} \frac{\partial X_j}{\partial x_m} \sigma_{km}, \tag{2}$$

$$E_{ij} = \frac{1}{2}\left(\frac{\partial u_i}{\partial X_j} + \frac{\partial u_j}{\partial X_i} + \frac{\partial u_k}{\partial X_i}\frac{\partial u_k}{\partial X_j}\right), \tag{3}$$

where X_i and x_k are the components of the positions vector of a point of the membrane in the undeformed configuration and deformed configuration, respectively; J is the Jacobian determinant which is given by J = det F with F being deformation gradient.

Infusion and Cure

While infusion and cure steps were separated above, they will be included together in the virtual steps because they are coupled with cure rate being a function of temperature and viscosity being a function of both temperature and degree of cure. All modeling of resin will use Hexcel RTM6 resin material properties.

Cure Kinetics

While resin is being infused through the fabric it is also curing. The cure kinetics of Hexcel RTM6 resin has been reported previously in the literature[3] by Panagiotis et al. and the cure kinetics model reported by them is also used in this simulation:

$$\frac{d\alpha}{dt} = (k_1 + k_2\alpha^m)(1-\alpha)^n, \tag{4}$$

where ki is defined as:

$$k_i = A_i exp\left(\frac{-E_i}{RT}\right), \tag{5}$$

with the model parameters
as outlined in table 2.

Parameter	A_1 (s^{-1})	E_1 (kJ/mol)	A_2 (s^{-1})	E_2(kJ/mol)	m	n
Value	20340	70.2	8658	53.2	1.28	1.51

Table 2: Cure kinetics model parameters.

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Infusion Modeling (Darcy's Law)

Darcy's Law states that the velocity of a fluid through a porous media is a function of the pressure gradient, viscosity of the fluid, and permeability of the porous media:

$$\nabla P = \frac{\eta}{K} v, \tag{6}$$

where v is the velocity vector, P the pressure, η the viscosity, and K the permeability tensor. In this equation the viscosity and permeability are material input parameters and the pressure and velocities are unknowns. The continuity equation is also needed to fully constrain the problem:

$$\frac{\partial \rho}{\partial t} + \nabla \cdot \rho v = 0, \tag{7}$$

where t is time and ρ is density. In-plane permeability of fabrics has been shown to be sensitive to shear strains[4], which is why the shear strains caused by draping are imported from the draping simulation and included in the simulation. The viscosity of the resin was modeled using the RTM6 viscosity model as reported by Kiuna et al[5]:

$$\frac{d\eta}{dt} = \eta \left[k(T) + \frac{1}{\eta_0} \frac{d\eta_0}{dt} \right], \tag{8}$$

where k(T) is defined as,

$$k(T) = A_2 \exp\left(\frac{-E_2}{RT}\right), \tag{9}$$

and η_0 is defined as,

$$\eta_0(T) = A_1 \exp\left(\frac{E_1}{RT}\right). \tag{10}$$

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Table 3 shows the parameters for the model described above.

Parameter	A_1 (Pa s)	E_1 (J/kg)	A_2 (s^{-1})	E_2(J/kg)
Value	7.3×10^{-4}	1.3×10[illegible]	7.4×10[illegible]	6.5×10[illegible]

Table 3: Viscosity model parameters.

Deformation

Part deformation during demolding coming from the relieving of internal stresses which develop during the molding and cooldown process will be modeled using Convergent's commercial simulation package COMPRO. The governing equations for the stress/deformation that develops during the molding, cooldown, and demolding steps are[6-8]:

where U is internal work, Ω is external work, ε is the strain tensor, σ is the stress tensor, ε_0 is free/thermal strain, σ_0 is the initial stress tensor, u is the displacement vector, X is body forces, and q_s is surface forces. There are several phenomena contributing to stresses and deformations during an HP-RTM manufacturing process. Typically the largest contribution to internal stresses in a carbon-epoxy part is the mismatch in coefficients of thermal expansion between the carbon fiber and the resin[9]. However, cure shrinkage, cure and cure rate gradients, and tool-part interaction also contribute[10].

$$\Pi_P = U + \Omega, \tag{11}$$

$$\Pi_P = \int_V \frac{1}{2}\varepsilon^T D\varepsilon\, dV - \int_V \frac{1}{2}\varepsilon^T D\varepsilon_0\, dV - \int_V \frac{1}{2}\varepsilon^T\sigma_0\, dV - \int_V \frac{1}{2}u^T X\, dV - \int_S u_s^T q_s dS, \tag{12}$$

continued on page 23...

Results

The simulations outlined in section 4 were completed on the B-Pillar geometry outlined in figure 4 and connected as described in figure 3.

Draping Analysis

When a fabric is preformed into a tool shape, there are three main modes of fabric deformation. The dominant deformation mode is shearing of the fabric by tows sliding past each other, or, if shear locking angle has been reached, wrinkling out of the plane. Bending of the fabric out of the plane is also important for the fabric to conform to a complex geometry. The last possible deformation mode is from the tows in the fabric stretching axially; however, because the fibers are so stiff compared to the other two deformation modes, axial stretching is a secondary effect in draping analyses.

The fiber tow modulus was measured using a TA Q800 DMA. The bending stiffness was measured using a Taber fabric stiffness tester. Both values are listed in Table 1. The shearing behavior is measured using a picture frame test, so called because the test fixture looks like a picture frame. The results of the picture frame test are shown in figure 5. Picture frame test results are typically comprised of a relatively flat region followed by a sharp increase in the slope at a certain point. This point is called the shear lock angle and corresponds to the point where the tows can no longer slide past each other and additional shearing can only occur by tows buckling out of the plane. This is also the point where wrinkling occurs and in this fabric the data shows that the shear lock angle occurs at around a 25 degree shear angle. The force as a function of shear angle is input directly into PAM-FORM. Given these inputs PAM-FORM estimates the fabric behavior as it is pressed in the mold. Figure 6 shows the shear angle of the preform in both the 45 layers and the 0 layers. The estimates show a significant amount of shearing (but well below the shear lock angle) in both plies at either end of the part.

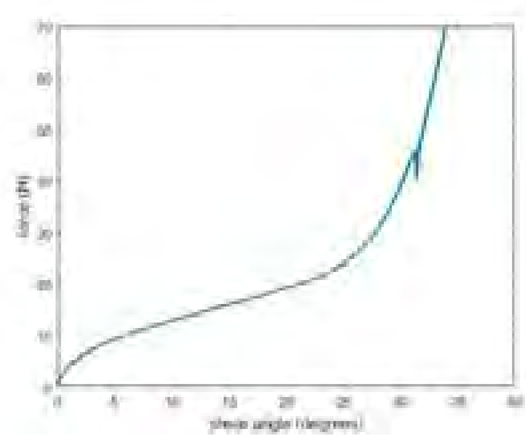

Figure 5: force as a function of shear angle of the carbon twill fabric.

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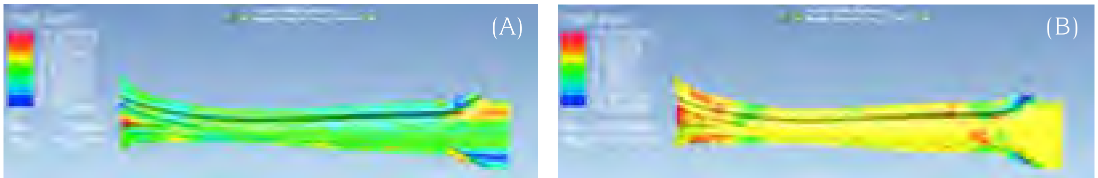

Figure 6: Shear angles for the pressed preform in the (a) top layer (0/90) and (b) second layer (45/-45).

Infusion and Cure Analysis

As previously mentioned, there are several things happening simultaneously during the infusion and cure step. Figure 7 outlines the state variables and dependencies of different physical phenomena that are occurring during this step.

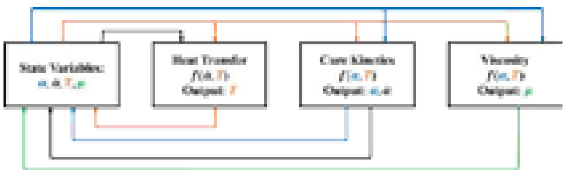

Figure 7: Flow of information during the infusion and cure step.

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The permeability of the fabric is listed in table 1 and the effect of shear angle on permeability was estimated based on the literature[11]. The shear angle were imported directly from PAM-FORM into PAM-RTM. A gate was placed in the center of the part and vents were placed along the edges in the long direction. Figure 8 shows a contour plot of the resin fill time and resin cure state at complete fill. This information can be useful for several reasons. First, the model can be used to minimize the fill time by optimizing the gate and vent locations, especially in areas of high shear which will change the permeability behavior. Also, the resin cure state at the time in which the infusion is completed is useful in predicting the part deformation, residual stress, and material properties.

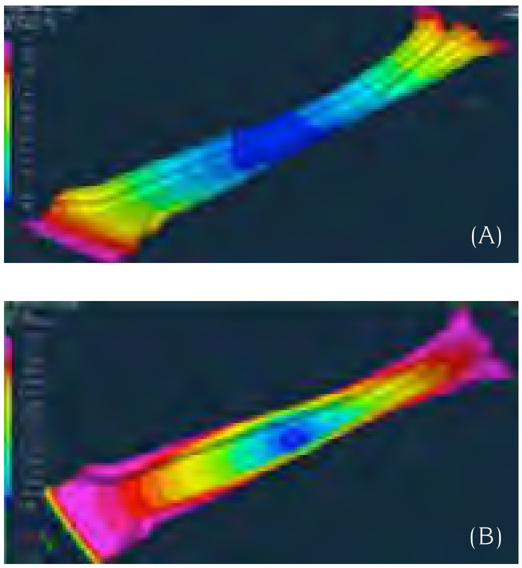

Figure 8: (a) Resin fill time and (b) degree of cure at complete fill.

Deformation Analysis

The stress and deformation analysis starts with the part at complete fill and ends with the cooled, demolded part. The final deformed shape as well as the residual stress after deformation are both predicted. Cure shrinkage and coefficients of thermal expansion are the factors driving the stress and deformation[12-13]. The draped fiber orientations are imported from PAM-FORM and the resin cure states at complete fill are imported from PAM-RTM. During the molding step, the part was constrained to be attached to the mold through a surface contact constraint. At demolding the contact constraint was removed and the only boundary constraints applied were to prevent rigid body motion. Figure 9 shows the deformation and residual stress of the draped part. As a means of comparison, the simulation was also run with the as-designed fiber orientation and uniform initial cure state. The results of this analysis are shown in figure 10. The as-designed part underpredicted the maximum deformation as compared to the part which in included manufacturing effects by almost 20 percent, highlighting the significant impact the manufacturing effects can have on the part properties.

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Tooling Geometry Compensation

If the deformation predicted by the COMPRO analysis is enough to make the part geometry outside of acceptable tolerance limits, then the tooling geometry can be compensated such that the part will deform into the desired shape[14-15]. This can be done by importing the deformation vectors from ABAQUS into CATIA using the Dassault product Composites Link and morphing the tool geometry by the deformation vectors but in the reverse direction. The process described above can be iterated until all analyses show satisfactory results. Figure 11 shows an example of the geometry compensation. Going through this end to end process simulation before beginning manufacturing or performance modeling provides several benefits: the process parameters such as gate and vent locations, pressure, and temperature can be optimized, the mold geometry can be made to account for process induced deformation, and the performance model can be made more accurate by modeling the as-manufactured part instead of the as-designed part.

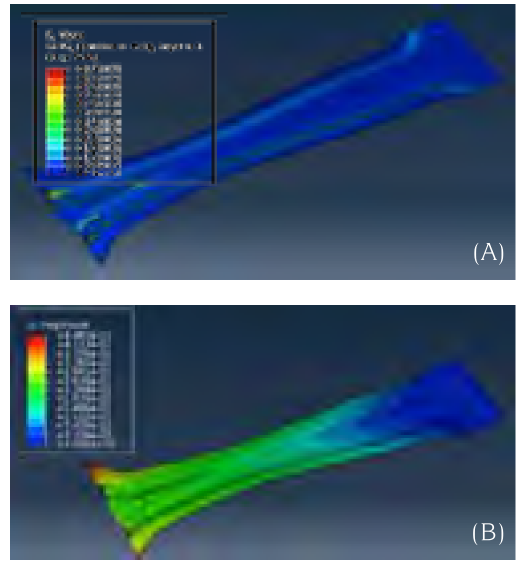

Figure 9: (a) deformation magnitude and (b) residual stress in part with imported orientation.

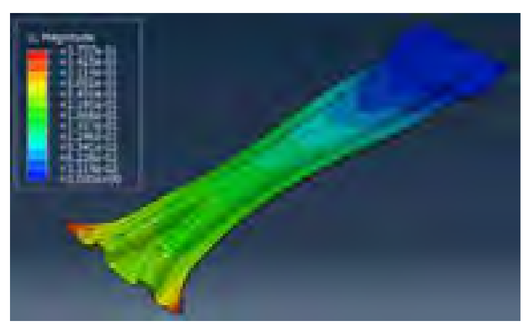

Figure 10: The as-designed part underpredicts deformation by almost 20 percent.

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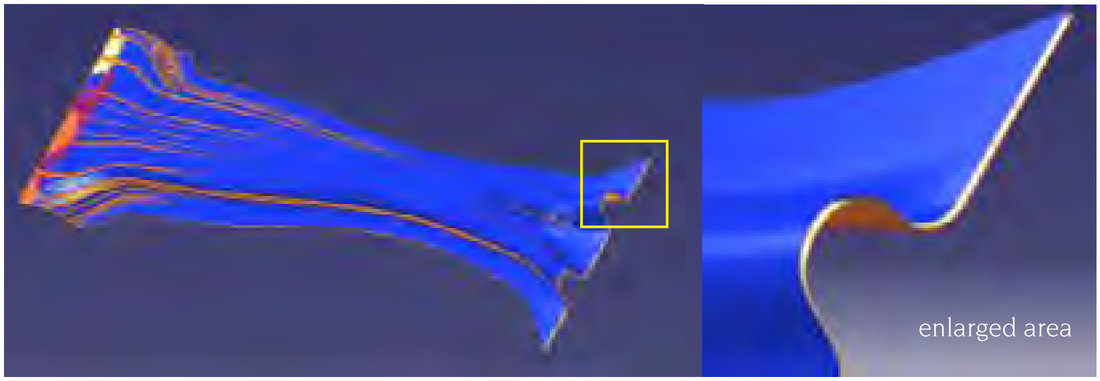

Figure 11: Geometry compensation using Composites Link *and* CATIA.

Summary and Next Steps

We have presented an integrated process simulation for high-pressure resin transfer molding. The process integrates the commercial simulation tools CATIA, PAM-FORM, PAM-RTM, ABAQUS and COMPRO to provide an end-to-end process simulation for the HP-RTM process. An example of the process was shown for a generic b-pillar geometry to illustrate the physical phenomenon and the simulation tool connectivity. Of particular interest is the prediction of fabric shearing, resin flow front and the final residual stress state and deformations and the resulting as-manufactured part geometry. The use of the process simulation to predict the tooling compensation necessary to achieve the as-designed geometry was illustrated.

More generally, in a part with geometrical complexity, the manufacturing process will cause the as-manufactured microstructure to differ from the as-designed microstructure. Since the composite's properties are highly dependent on its microstructure, manufacturing can significantly affect the deformation of the part, its residual stress state and its strength and stiffness performance. While these phenomenon have been demonstrated for HP-RTM using an end-toend process simulation, the implications of manufacturing-informed performance apply to composites manufacturing in general.

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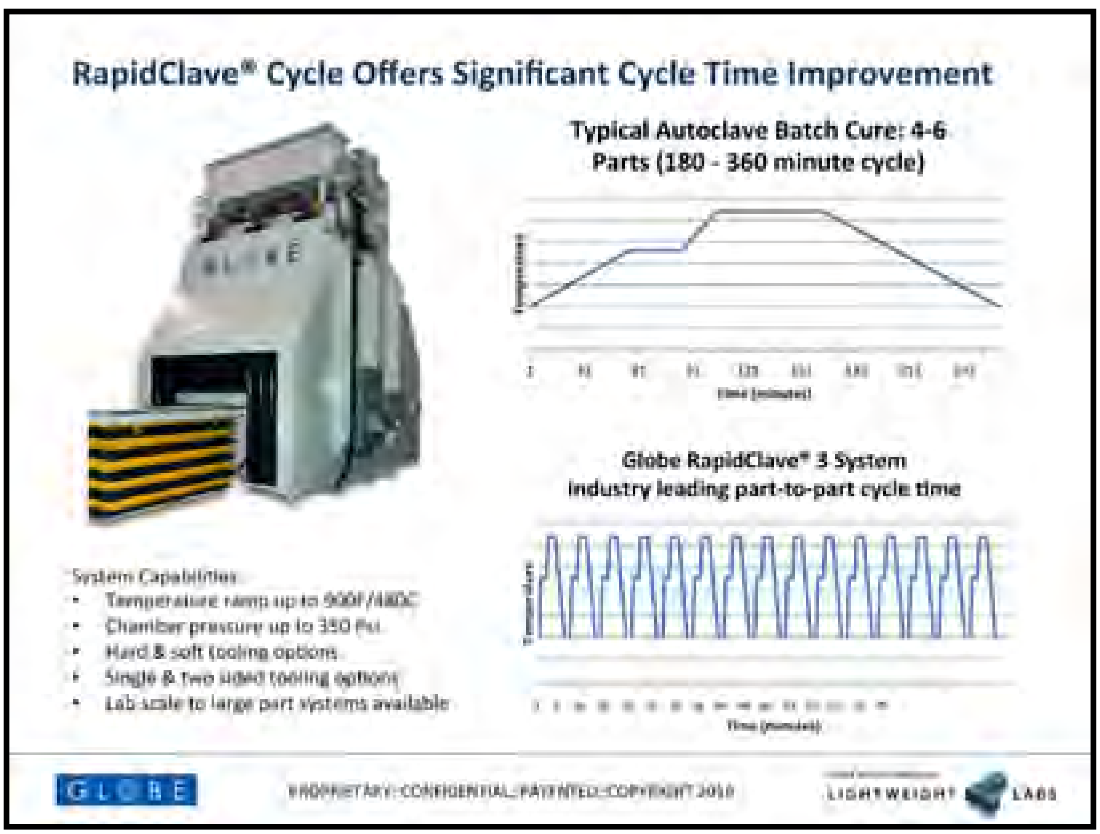
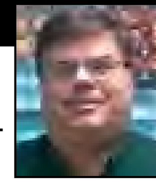


Award List 2018

By: Dr. Dale Grove



Award	Description/ Requirements	Amount	Total (max, annual)
ACCE Graduate Scholarships*	• Two for full time grad students + one grad or undergrad attending school in Michigan • Students in good standing and pursuing a degree in Polymer Science, Composites, Plastics or a related Engineering discipline • A two-page essay is required showing planned work and how it will benefit composites in an automotive or other ground transportation application. • A letter of recommendation from the student's advisor or mentor is also required • Recipients are required to present their research project at the next ACCE conference	3x$2000 (awards) 3x$500 (travel)	$7500
Harold Giles Scholarships	• Two awards presented to one undergraduate and one graduate student • An essay documenting experience in the composites industry is required (courses taken, research conducted or jobs held) • Winners are typically students who not only maintained a good grade point average but also served their community, had some experience in the composite area, and are backed by solid reference letters from former professors and employers	2x$3500 (awards) $1000 (increase endowment)	$8000
Student Travel Award	• The student must attend ANTEC 2018 to either present a paper or poster. • The two winners are selected based on a 250-word abstract describing their composites research • No shows will receive no award.	2x$1500 (travel + awards)	$3000

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Dr. Jackie Rehkopf Scholarships*	• A single full time graduate student or two undergraduate students if no graduate students qualify • Focus should be on research activities targeted to ground transportation composite technology • Students must be in good academic standing and pursuing a degree in Polymer Science, Composites, Plastics or a related Engineering discipline • A 2-page essay is required showing planned work and how it will benefit composites in an automotive or other ground transportation application • A letter of recommendation from the student's advisor or mentor is also required • Scholarship recipients are required to present work at an SPE technical conference and/or have it published in an SPE technical journal	1x$5000 OR 2x$2500 (awards) $1000 (increase endowment)	$6000
Educator of the Year	• Someone in the educational field (high school, university or college-level) • Has made a significant contribution to the training of students in the composites area. E.G.: the creation of new educational programs the development of new pedagogical tools motivating students to enter the composites sector • Selection will be based on contributions made during the previous year. • Must submit a nomination form and two letters of support • They must also be part of the special Composite Educator session during ANTEC.	$2500 (award)	$2500
Total:			$27,000

*Awards that are done in coordination with the Automotive Division of SPE and ACCE.

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SPE COMPOSITES DIVISION

COMPOSITES
EDUCATOR OF THE YEAR 2018

Submission Deadline: February 15, 2018

The **Composites Division** of the Society of Plastics Engineers is pleased to announce that it has begun accepting nominations for the **COMPOSITES EDUCATOR OF THE YEAR 2018.** The winner receives a plaque and a cheque for $2500. The winner of this award will be presented at ANTEC during a special Composite Educator session.

The **COMPOSITES EDUCATOR OF THE YEAR** is someone in the educational field (high school, university, or college-level) who has made a significant contribution to the training of students in the composites area. Examples of contributions would include the creation of new educational programs, the development of new pedagogical tools, and motivating students to enter the composite sector. It will be primarily based on contributions made during the 2017 calendar year.

To participate please submit: (1) the attached nomination form, (2) two letters of support for the nominee. Send the completed application to Dr. Dale A. Grove (grove.dale@hotmail.com) **before February 15, 2018**. Judging will be done by industry members of the SPE Composite Division's Board of Directors. (3) Also state your interest to present during the special session by emailing Rich Caruso rpcaruso@gmail.com or Srinivasan, Gowrishankar [CIRAS] srigshan@iastate.edu.

SPE Composite Division Educator of the Year 2018 Application Form

Nominated educator (name, position, institution, telephone number, email address)	
Reason for nomination (250-500 words)	
Reference #1* (name, position, institution, telephone number, email address) Each reference must write a one page letter of support explaining how the nominee has made a significant contribution to the training of students in the composites area in 2017.	**Reference #2 (name, position, institution, telephone number, email address) Each reference must write a one page letter of support explaining how the nominee has made a significant contribution to the training of students in the composites area in 2017.**

* This person can also be the nominating person.

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Call For Nominations

Harold Giles Scholarship

The Composite Division continues to offer a scholastic scholarship in honor of the late Dr. Harold Giles, a past Composite Division Awards Chair. As a former University Professor at the University of North Carolina, Azdel employee, and GE employee, Harold Giles knew full well the value of student scholarships. He was always a proponent of awarding worthy students and served the society well in this capacity.

Two $3500 scholarships will be offered—one for an undergraduate student and the second for a graduate student. These scholarship awards are open to outstanding students who not only maintain a good grade point average but also serve their community, had some experience in the composite area, and are backed by solid reference letters from former professors and employers. If you are or know of worthy candidates for this scholarship, please consult the SPE foundation at the following website:
http://www.4spe.org/Foundation/?navItemNumber=639

If you have any questions, please contact Tim Johnson or Dale Grove.
The Foundation due date is April 1st, 2018.

Tim Johnson
Composite Division Treasurer
TJohnsonLLC@gmail.com

Dr. Dale Grove
Composite Division Awards Chair
grove.dale@hotmail.com

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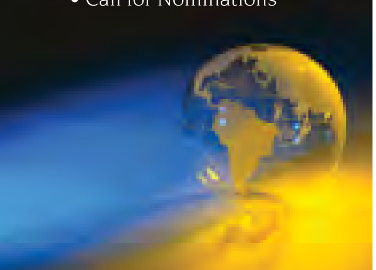

Call For Nominations

SPE COMPOSITES DIVISION

STUDENT TRAVEL AWARD 2018

Submission Deadline: February 15, 2018

The STUDENT TRAVEL AWARD provides travel and award funding for two composite students who are either presenting papers or posters at the upcoming 2018 ANTEC in Orlando. The award is open to both undergraduate and graduate students.

The two winners will be selected based on a 250-word abstract describing their **composite** research. A panel of industry representatives serving on the Composite Division board will judge the submitted abstracts and select the two winners. (For this year only, one of the selections may be a previous METTLER TOLEDO AWARD winner due to the award's legacy.) Each winner will receive $1500 dollars for travel and award funding. Procedures for submitting papers to ANTEC 2017 will be found on SPE's website http://www.4spe.org/.

Note that the travel award will be forfeited if the student does not appear at ANTEC; checks will only be issued after the student presents their work. To be considered, candidates must write a 250-word abstract on their research and complete the form below. The abstracts and form must be emailed before February 15, 2018 to grove.dale@hotmail.com (Awards Chair).

Name:	
Program (Undergraduate/Master/Doctoral):	
Date graduate program started:	
College or University:	
University Supervisor:	
Address:	
Phone Number:	
Email:	

Please insert below your abstract of 250 words or less that describes the research

Title: Abstract:

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The Composite Division is actively seeking new sponsors for our Student Travel and Educator of the Year awards

The Student Travel award presently offers two $1500 dollar awards to enable students to attend ANTEC to either present a paper or poster, while the Educator of the Year Award offers a single $2500 payment to the best Educator of 2017. This is your company's chance to support these worthwhile awards by sponsoring ½ to 2/3 of the awards amount. If you are interested, please contact the following Composite Division board members:

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