CompositesWorld Expo 2009 - Conference Agenda

Monday, September 28 – Introductory Track

Chaired by Louis A. Luedtke, Managing Partner, BerryHill Partners LLC

7:30 – 8:30 am ***Continental Breakfast***

8:30 – 10:00 am **Introduction to Composite Materials and Their Role in Green Applications**
Dr. Carl Zweben, Life Fellow ASME, Fellow SAMPE & ASM

Composites are enabling materials for a vast array of efficient aerospace/defense, marine, industrial, infrastructure and consumer products, including green energy production and storage. In addition, because they produce lightweight structures, their use reduces energy consumption in vehicles, aircraft and machinery. Green energy applications include wind turbines; photovoltaics and other solar energy products; fuel cells; fuel tanks for natural gas and hydrogen vehicles, and flywheels. Composites are making great contributions to new infrastructure applications, and restoration of crumbling ones. Lightweight composite thermal management materials provide great benefits for hybrid and electric vehicles and solid state (LED) lighting, which is more efficient and long-lasting than incandescent. This presentation provides an introduction to composites for both those having little background and those desiring to expand their knowledge. It provides a basic overview of the four key classes of composites: polymer matrix, metal matrix, ceramic matrix and carbon matrix, focusing primarily on the former. Topics include:

- Basic definitions and types of composites
- Key fiber reinforcements and matrix materials
- Properties of key composite material systems
- Use of composites in injection molding compounds and molds
- Industrial, infrastructure, aerospace/defense, consumer and green applications

10 – 10:30 am **Refreshment Break**

10:30 am – Noon **Introduction to Composites Fabrication Techniques**
Terry Price, Director, Composites Training Center, Cerritos College

Noon – 1:00 pm **Networking Luncheon**

1:00 – 2:30 pm **Design and Manufacturing Software I**
Fly Like the Wind: What Wind Energy Companies Can Learn from Aerospace Composites Best Practices
Rani Richardson, CATIA North America, Dassault Systemes

2:30 – 3:00 pm **Refreshment Break**

3:00 – 4:15 pm **Integrating Process with Design**

Monday, September 28 - Advanced Track

Chaired by Sara Black, Technical Editor, High-Performance Composites

7:30 – 8:30 am ***Continental Breakfast***

8:30 – 10:00 am **Realizing the Full Potential of Composites across Industries**
Olivier Guillermin, Director Product & Market Strategy, VISTAGY

Composites hold a lot of promise, including weight savings, part consolidation, lower assembly costs, the elimination of fasteners, superior damage tolerance and corrosion resistance, lower life cycle costs, tailored properties, design freedom, and new business opportunities.

However, these benefits come with significant challenges, such as the design constraints imposed by the material and process on part shape and configuration and the increased number of variables that must be controlled to achieve an optimal design.

In a nutshell, composites engineering is a delicate balancing act in which an equilibrium must be reached between the part shape and configuration, material form, and manufacturing process.

A number of industries are facing composites changes:

- The aerospace industry is currently learning how to achieve high production rates, manufacturing repeatability, joining and fastening, and the inspection of "blind" composite parts.
- The automotive industry is taking a serious look at the use of composites for exterior, structural and interior applications with new materials and new processes.
- Jet engine manufacturers are ramping up the use of polymer and ceramic matrix composites in fan blades and turbine blades so they can produce lighter and quieter engines.
- The wind energy industry is growing at an unprecedented pace both in worldwide installed power and in wind turbine size. Rotors are reaching dimensions that require the use of innovative designs, materials and processes.

10 – 10:30 am **Refreshment Break**

10:30 am – Noon **RTM / Infusion Numerical Simulation**
David Prono, Application Engineer, ESI North America

- RTM simulation: The state of the art
- Benefits of simulation
- RTM simulation in CATIA
- Live demo

Machine-Independent Automated Fiber Placement Programming & Simulation
Bill Hasenjaeger, Product Marketing Manager, CGTech

Most users of CNC Automated Fiber Placement (AFP) machinery use off-line NC programming software delivered with their machine, forcing companies to adopt multiple software applications for multiple brands of machines.

The more mature CNC metal-cutting industry started the same way, but has now evolved into a clear separation and cooperation between independent software and machine suppliers, freeing the company to select the best machine for the job, while using one software application to create NC programs for a variety of machine brands.

When combined with composite design software tools that specifically take into account AFP manufacturing requirements early in the product development cycle, engineering and manufacturing specifications are seamlessly transferred to the manufacturing process. This presentation will discuss the implementation and use of machine independent off-line NC programming software as it applies to CNC fiber placement machines.

Key Points:

- Introduce the key components of machine independent off-line programming software
- Highlight advantages and challenges with this approach in the industry today
- Discuss how machine independent software fits in future technology development
- Show how the flow of information from composite design to programming software produces optimum processes

Noon – 1:00 pm **Networking Luncheon**

1:00 – 2:30 pm **Composites Tooling: Back to the Future**
Larry L. Carver, Carver Composites Tooling
Clark R. Smith, Sales and Marketing Manager, HexTOOL, Hexcel
Alan Hiken, Vice President Engineering & Technology, Rubbercraft

This session will focus on the development of composites tooling by looking at the past and the future design and materials application of composites in aerospace tooling.

- Back ground overview of composites development projects, U.S. Defense Advanced Research Projects Agency (DARPA) and United States Air Force & US Navy projects
- Challenges with using composite materials for aerospace tooling
- Case study on the development of Hexcel's HexTOOL, BMI and epoxy tooling system
- A look at current composites tool design systems
- Overview about carbon foam tooling technology
- Current tooling applications using carbon foam and BMI tooling
- What's next? 800 degree tooling
- Panel and open discussion with the audience

Development and Application of BMI and Carbon Fiber for Aerospace Tooling
Bob Vale, Manufacturing Technology Development, Northrop Grumman Corporation – Aerospace Systems

Monday, September 28 - Advanced Track (continued)

2:30 – 3:00 pm **Refreshment Break**

3:00 – 4:15 pm **From Design Room to the Cutting Room Floor: How Automation Maximizes Throughput**
R. Trevor Stevenson, Vice President Technical Services, Eastman Machine

Tuesday September 29 - Introductory Track

Chaired by Louis A. Luedtke, Managing Partner, BerryHill Partners LLC

7:00 – 8:00 am ***Continental Breakfast***

8:00 – 9:30 am **Sheet Molding Compound (SMC): Materials and Processes**
Rob Seats, Product Manager, Ashland Performance Materials

- Introduction to SMC
- Low mass nanocomposite case study
- Alternative materials (bio-based solutions)

Introduction to Pultrusion
Thomas Wright, Business Development Manager, Bedford Reinforced Plastics Inc.

1. Brief history of the pultrusion process.
2. Equipment used in the process
    a. Pullers
    b. Tooling
    c. Wet out systems
3. Material selection
    a. Reinforcements
        i. Fiberglass roving and CFM
        ii. Woven and stitched fabrics
        iii. Carbon fiber
        iv. Aramid
    b. Resins
        i. Polyester & vinyl ester
        ii. Epoxy
        iii. Phenolic
        iv. Urethane
4. Processing
    a. Material forming and layout
    b. Wet out
    c. Curing
    d. Inspection
    e. Quality issues
5. Typical Properties
6. Testing and Specifications
    a. Development of the LRFD
7. Secondary fabrication techniques
8. Applications

The pultrusion process starts with the reinforcements. Typically, uni-directional E glass roving begins the process. This is the fiber that runs along the length of the profile. Then a multi-directional E glass stitched fabric is added for reinforcement. Next, the glass reinforcements are "wet out" with a thermoset resin, typically polyester or vinylester.

Finally, just before all the material is pulled into the heated die, surface veil may be added to enhance the surface appearance of the final product. Curing of the composite is the next step in the pultrusion process. The curing or hardening occurs while the wet out reinforcements are being pulled through the heated die. The heat from the die causes the resin to cure and by the time the part exits the die, a hard part in the exact shape of the die cavity has been formed.

The final result is a solid, rigid profile with all the reinforcements laminated within. The product exiting the die is then pulled by the puller to the cut-off saw, which cuts it to the desired length.

9:30 – 10:00 am **Refreshment Break**

10:00 – 11:30 am **Out of Autoclave Prepreg Processing Technology – An Overview**
Chris Ridgard, Vice President Technology, Advanced Composites Group

Out of autoclave (OOA) processable composite materials have been used for the manufacture of composite parts in the aerospace, defense, marine and other industries since the 1990's. The material technology and associated processing knowledge have however advanced considerably in the last decade with major advances in quality and mechanical performance. Obvious advantages of OOA processing include the removal of size constraints and the potential to produce large integrated structure assemblies in fewer operations. This potential has clear advantages for applications in markets such as wind energy where the trend is clearly for larger, more efficient structures to be employed. The optimization of these materials for automated processes such as advanced fiber placement is also believed to be a key element of technology development in certain other industries such as aerospace, which is now taking place.

The status of current OOA technology in various industries is reviewed and future development steps are postulated. The target performance requirements differ between applications and markets as has always been the case with conventional autoclave curing materials and predictions are made of how OOA product ranges will be developed to similarly meet differing needs.

Fabrication Methods for Continuous Fiber Reinforced Thermoplastics (CFRT®)
Thomas Smith, President, Performance Materials Corp.

- Comparison of thermoplastic and thermoset processes
- Thermoplastic material forms (sheets, tapes, chopped tapes, hybrids)
- Cutting methods and "kitting"
- Heating methods, transfer and molding

CFRT is an emerging technology in the composites industry. It lends to rapid manufacturing of complex high performance parts. However, processing methods and equipment for these materials are not prevalent throughout the industry.

This presentation will review various fabrication methods, techniques and equipment which are used to produce components made from Continuous Fiber Reinforced Thermoplastics (CFRT®). These materials exhibit mechanical properties of thermoset composites, but they can also be manufactured into parts at high volume and with rapid cycles.

The basic material forms of CFRT will be reviewed including various polymer and fiber combinations with examples of material properties.

The methods for converting the materials into parts will be examined including the design of engineered constructions. The manufacturing operations of cutting, kitting, heating, transfer and molding will be discussed.

The methods selected will depend upon the specific material, part design as well as other manufacturing considerations.

The advantages and disadvantages of each process method will be reviewed.

Examples of sample CFRT parts will be shown.

11:30 am – 1:00 pm

Networking Luncheon and Keynote Presentation

1:00 – 2:30 pm **Advances In Vacuum Infusion Processing of Composite Materials**
Andre Cocquyt, President, GRP Guru.com

2:30 – 3:00 pm **Refreshment Break**

3:00 – 4:15 pm **Preforming: Past and Present**
Daniel T. Buckley, Manager of Research & Development, American GFM

Tuesday, September 29 - Advanced Track

Chaired by Sara Black, Technical Editor, High-Performance Composites

7:00 – 8:00 am ***Continental Breakfast***

8:00 – 9:30 am **Automated Manufacturing of Composite Structures I**
Moderated by Carroll Grant, Aerospace Composites Consulting

High Output Automated Composites Part Manufacturing
Jacques Berruet, Liné Machine Tools (Forest-Liné Group)
In a world where productivity is a major driver, Forest-Liné will to present the latest developments in Fiber Placement technology and in Tape laying technology. In the continuing quest to reduce operating costs for customers, airframe weight reductions are usually a primary objective as aircraft companies design new aircraft models. Weight reduction is normally achieved by a combination of airframe design optimization and the use of larger amounts of lightweight composite materials. The output capabilities of manufacturing processes used for building these large structures becomes a major issue.

The first goal was to develop automated machines for composite manufacturing, and from there on, it is productivity that is a major criteria. Productivity is not only a layup rate, it is a layup rate coupled to process reliability. The ATL (Advanced Tape layup) process is especially known for its high material lay up rate capabilities. The AFP (Advanced Fiber Placement) process gives layup possibilities in non developable, compound curvature areas. This paper will provide an overview of ATL technology and latest enhancements, and put the main focus on the latest AFP layup technologies.
Forest-Liné is major builder of high-output composite prepreg Tape Layers and Fiber Placement machines and is recognized worldwide for its large sized high precision machine tools.

Right-Sized AFP & ATL
Clarissa Hennings, Automated Dynamics
Prime contractors across industries outsource fabrication to their suppliers and provide business growth opportunities. Automation allows manufacturers to provide consistent, quality products to their customers. Automated fiber placement (AFP) and automated tape laying (ATL) provide those attributes to composite structure layup.

With growing use of composites across many industries, contractors are seeking the benefits of automation for a wider range of structures in addition to the larger parts typically fabricated using AFP and ATL. Additionally, affordable machines are necessary to justify automating the layup of smaller and many atypical structures: an acceptable payback on the machine purchase for these structures can be realized through purchasing lower cost machines. Alternative methods of gaining the advantages of and experience with AFP and ATL are through smaller investments in R&D equipment and consortiums. This paper describes how purpose built automation can provide the advantages of AFP and ATL to manufacturers who build structures outside of large fuselage sections and wing skins. This paper also outlines specific examples of lower cost machines in production and as part of consortiums, and the advantages associated.

Choosing (or Developing) the Right AFP / ATL Automation Processes for Composites Manufacturing
James P. Martin, President, Innovative Composites Automation

- Combine processes for efficiency
- Utilize industry experts to shorten the learning and procurement cycles
- Develop application-specific technology; don't settle for vendor-standard
- Write bullet-proof specifications to ensure accurate deliverables

9:30 – 10:00 am **Refreshment Break**

10:00 – 11:30 am **Automated Manufacturing of Composite Structures II**
Moderated by Carroll Grant, Aerospace Composites Consulting

Optimized Machining and Inspection for Composite Manufacture
Mark Saberton, Chief Aerospace Engineer, Flow International Corp.

- Multi-process machining
- Use of abrasive waterjet
- Routing, drilling, milling
- Inspection post machining

Developments in Machining and Inspection for Composite Manufacture
Brett Hopkins, Business Development, Delcam

11:30 am – 1:00 pm

Networking Luncheon and Keynote Presentation

1:00 – 2:30 pm **A Global Collaborative Approach to Manufacturing Excellence for Composites across the Life Cycle of a Production Program**
Romain Lavault, Vice President Strategic Development, Intercim LLC

Composite Manufacturing at a large scale requires process excellence and predictability at all stages from the engineering office to the shop floor, even if by nature composites are challenging to manufacture at a high degree of replicability and constant quality.

Some of the most advanced manufacturers on the planet have not only automated a lot of these previously manual processes, they have also put in place an infrastructure to actively drive processes and get real-time insight on the different processes, with alarms and automated notifications so as to be able to act and prevent defects as early as possible in the value chain.

Quality escapes like delamination or porosity can be quickly tracked, understood, resolved and avoided by engineers, manufacturing experts and operators as a team. Intercim and Dassault Systemes will present these techniques which allow to:

- Link the engineering specifications and the process definition/simulation to the realities of the shop floor over the life cycle of a program
- Lean out and automate collaborative processes in production and between engineering and shop floor
- Enforce traceability and best practices on the shop floor, as automatically discovered from previous high quality production units in the same plant
- Benefit from an early warning system in production so that defects can actively be avoided before being propagated too far down in the value chain
- Reconcile all the production information and build a shared and real-time view of the work in progress as well as a common behavior model of the composite manufacturing line under all circumstances
- Achieve faster and more secure time-to-market and production ramp-up, with sustained levels of quality and performance at higher production rates

All the methodologies, processes and benefits will be illustrated with real stories and actual manufacturer data and experience in North America, Europe and Asia-Pacific.

2:30 – 3:00 pm **Refreshment Break**

3:00 – 4:15 pm **Advances in NDT Methods for Composite Manufacturing**

High Speed Ultrasonic Inspection of Composites using "Acoustography"
Jaswinder S. Sandhu, Santec Systems, Inc.
Gary Georgeson, The Boeing Co.,
Charles Pergantis U.S. Army Research Laboratory

Current ultrasonic inspection practice of performing point-by-point scanning of the test part using single (or pair) ultrasound probe is inherently slow. As the use of composites ramps up in various industries and the production rates increase, the current point-by-point scanning practice is unlikely to meet the high throughput requirements.

This paper will report on the development of "Acoustography" to provide high speed ultrasonic inspection of composites. Acoustography differs from conventional point-by-point ultrasonic scanning in that it is an area inspection technique.

The approach uses a novel, super high resolution large area acousto-optic (AO) sensor, which allows x-ray like imaging of the inspected area to instantly reveal defects. We will report progress being made on develop Acoustography-based ultrasonic inspection systems that allow dramatic increase in inspection throughput (e.g. 5x or 10x). A number of case studies showing how Acoustography could bring value in terms of simplicity, inspection throughput, cost-savings, etc will be presented. A direct side-by-side comparison with conventional c-scan imaging on a variety of representative aerospace composite parts will be provided.

High Resolution, Low Cost Ultrasound Camera for In-Service Composite NDI

Robert Lasser, Marvin Lasser, Ron Westernik, John Kula, and David Rich, Imperium, Inc.

Ultrasound is one of the best nondestructive methods for finding internal defects within composites, but current ultrasonic testing requires a highly trained specialist. Accidental impact damage cannot easily be found and quantified.

A quick and easy inspection of aircraft composites in the field is badly needed. Through an ongoing project with Boeing, Imperium, Inc. will report on the results of the use of a novel ultrasound camera for in-service NDT of composites that alleviates these limitations. The ultrasound camera is based on a patented imaging array that generates real time ultrasound images over an area, similar to a conventional camcorder. A non-specialized technician can easily interpret the video. To use, a handheld probe is placed against the target under study and real time subsurface imagery appears on a display. The system is fully portable and requires little training. Compared to other NDT methods, the advantages of this include very rapid damage assessment. During this paper we will report on Boeing's implementation of device as describe some results that the device has provided. We will also report on the system being used in a field environment by non-specialists at an airport loading gate by airlines.