

# ***SAMPE '09 Tutorial Descriptions***

Monday, May 18, 2009

Baltimore Convention Center, Baltimore, MD

Register at [www.sampe.org](http://www.sampe.org)

## ***Rates:***

With Conference Registration: \$200

Full Time Student: \$100

Other Registration: \$250

## ***9:00 AM – 12:00 PM***

### ***Test Methods for Composite Materials and Structures***

Don Adams, Wyoming Test Fixtures, Salt Lake City, UT

Intended as both an introduction for a novice as well as a strong refresher for the experienced individual, this tutorial covers the essentials associated with designing a test, fabricating representative material samples and conducting the test appropriately. Test methods are important to established industries such as aerospace – but more recently are becoming more important for qualifying materials and structures within the wind energy, oil and gas, solar energy, alternate fuels, repair and maintenance, compressed natural gas (CNG, NGV), and hydrogen fuel areas. Consequently, this tutorial will be directed toward the proper selection of test methods for specific applications, from many methods currently available. This tutorial will focus on:

- Specimen selection and preparation procedures,
- Industry standards within various market segments,
- Tensile, compressive, flexure, shear and fracture toughness tests,
- Testing of unidirectional, laminated materials, sandwich structures, random fiber reinforced materials and fabric composite materials,
- Special problems associated with bonded interfaces and environmental aspects (high, low temperatures), and,
- Numerous examples across several industries

## ***9:00 AM – 12:00 PM***

### ***Introduction to Composite Materials***

Carl Zweben, Consultant, Devon, PA

Composites are enabling materials for a vast array of aerospace/defense, marine, industrial and consumer products, including green energy production and storage. Green energy applications include wind turbines, oil and gas exploration, production and transportation, photovoltaic's and other solar energy products, fuel cells, flywheels, etc. Lightweight vehicles, aircraft and machine parts reduce energy consumption. Thermal management is critical for hybrid and electric vehicles. This tutorial 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. Emphasis will be on basic concepts and practical applications.

Upon completion, participants will have a basic understanding of composites that can be applied on the job. Some of the topics that will be covered are:

- Basic definitions and types of composites,
- Key fiber reinforcements and matrix materials,
- Properties of key composite material systems,
- When composites should and should not be used,
- Industrial, aerospace/defense, consumer and green energy applications
- Lessons learned within the composites industry

### **9:00 AM – 12:00 PM**

#### ***Resin Infusion and Liquid Molding Processing Technology***

Dirk Heider, University of Delaware, Newark, DE

This tutorial reviews the various resin infusion and liquid composite molding processes currently in use across many aerospace, commercial and industrial market segments today. These processes have been proven to manufacture high-performance parts while reducing costs compared to conventional autoclave processing. The tutorial will introduce the fundamental process physics and compare the benefits and disadvantages of the various implementations. The VIP (vacuum infusion process) method has been gaining popularity in recent years and, in particular within the rapidly growing wind energy sector, where RTM, VARTM, SCRIMP and other process variants exist. Thus the wind energy application will be a strong focus of this workshop. The tutorial will provide an overview of tooling and preform technology and review various industrial applications. The topics which will be presented are:

- Basics of LCM processing technology,
- Materials review that includes:
  - Resin families of interest,
  - Fabrics and preform materials, and,
  - Core materials
- Overview of resin flow issues (within the tool and preform structure),
- Modeling in-mold flow behavior and wet out,
- Tooling and preform technologies, and,
- Various examples of applications

### **9:00 AM – 12:00 PM**

#### ***Repairing Composites: Decisions, Materials and Methodologies***

Louis Dorworth, Abaris Training Resources Inc., Reno, NV

This tutorial will be of interest to those involved in repairs to composite structures. Basic requirements for performing reliable structural repairs to composite components and large scale structures will be addressed. This presentation applies to many different industries ranging from aerospace to wind energy to motorsport racing. In this tutorial the pros and cons of using different materials and methodologies so that engineers can choose the appropriate repair design that best suits the type of structures that they are repairing will be presented and discussed. Applicable tools and equipment are identified with some emphasis on the new equipment specifically designed for wind energy blades

and other large scale surface repairs requiring moderate temperature cure cycles. Questions are encouraged during the presentation as it is designed to be an interactive discussion format. Topics included in the presentations will include:

- Defining whether the repair is possible for the damaged structure,
- Establishing the appropriate materials and process for the repair,
- Preparation of the repair region,
- Repairing the damaged region back to structural sufficiency,
- Assessing, inspecting and assuring repair conformance and integrity, and,
- Analyses associated with typical repairs (if any)

**2:00 PM – 5:00 PM**

***Composites Fabrication and Manufacturing Overview***

James Leslie, ACPT Inc., Huntington Beach, CA

One of our most popular tutorials, this one emphasizes the inherent environmentally friendly nature of composite materials and provides a comprehensive overview of the advantages offered by composite materials and the techniques by which they can be manufactured into useful structures and hardware components. An explanation of why composite materials are finding increased use in both commercial and aerospace applications is presented to the attendees. Attendees receive an in-depth review of the numerous techniques used for manufacturing composite structures. Some of the methods covered involve: filament winding, vacuum bagging, hand lay-up, pultrusion, resin transfer molding (RTM), vacuum-assisted RTM, thermoforming and various hybrid processes. Examples of applications within the aerospace, commercial, oil and gas, wind energy, pressure vessels used for fuel tanks (CNG, NGV, LPG and hydrogen) and other areas will be covered. Some of the topics covered in this tutorial are:

- A review of some of the uses of composites in petroleum exploration and production,
- Extensive coverage of composites and FRP processing methods,
- What processes and applications best fit together,
- Illustrating “how-to” manufacturing logic with composites,
- What composite materials (resins, fibers ,and forms) work best and when,
- Selection criteria for picking resins and fibers for specific applications,
- Discussion of auxiliary equipment and materials for processing,
- Open forum for questions concerning today’s manufacturing methods, and,
- Extensive presentation of composites manufacturing processes and applications.

**2:00 PM – 5:00 PM**

***Thermoplastic Composites Technologies***

Dr. Conchur O’Bradaigh, ÉireComposites/Composites Testing Laboratory, Galway, Ireland

Thermoplastic (TP) composites are “Green” in that they can be recycled at their end of life to produce other useful reinforced composites. These composite structures can also be thermally-welded, in-situ tape placed and in-situ polymerized, all of which helps avoid the need for adhesives, which can complicate the end of life disassembly and recycling processes. The design and processing of these materials into high performance composite structures often can be very challenging. However, an attendee will learn why they are so attractive in many applications if proper trade-offs are performed with respect to their attributes and potential. The presentation of various market sector applications, through three Case Studies, provides a much needed insight into “why thermoplastic composites” work across numerous markets. Some of the topics covered are:

- Introduction to various thermoplastic composites available today,
- Understanding: material forms, properties, processing routes, economic drivers, important applications,
- Press-forming, autoclave-molding, automated tape placement, vacuum molding and liquid molding – where to start and when,
- Secondary processing importance: resistance welding, induction welding, vibration welding,
- Recycling strategies for thermoplastic composites – with examples,
- Important material suppliers and vendors, and,
- Three (3) Case Studies: Wind Energy, Automotive, Aerospace

**2:00 PM – 5:00 PM**

***Design, Analysis and FEA Modeling of Composites***

DeWayne Howell, Peak Composites Inc., Arvada, CO

This composites design and analysis overview brings this complex subject down to earth. Industry-accepted methodologies are introduced and practical examples are given to enhance the understanding of each topic. Emphasis is placed on guidelines for making composite design and analysis more effective and *efficient so that the attendee’s designs will be leaner and “greener”*. Participants will receive a handy Composites Design Guide as part of this experience. Various examples will be represented using commercially available closed-form and finite element (FEA) based software, and, a brief overview of available software will be offered. Topics included in this tutorial are:

- Fiber and matrix materials *spotlighting recyclable thermoplastics and natural fibers*,
- Micromechanics and laminated plate theory (LPT),
- Laminate design guidelines and laminate failure criteria,
- How to handle environmental considerations,
- Joining methods and design,

- Design of structures and fabrication considerations,
- Software for design & analysis, FEA of composite structures, and,
- Example application of a *hybrid electric transit bus* composite structure.

**2:00 PM – 5:00 PM**

***Filament Winding and Automated Fiber Placement Processing***

Axel Seifert, Material S A, Brussels, Belgium and Michael Skinner, Skinner Creative Inc., Draper, UT

Filament winding and fiber placement are two processes for fabricating composite structures. Each is more applicable to certain kinds of products and has advantages and disadvantages within the various markets. This tutorial will introduce the processes, highlight current applications of each process look at the processes advantages and limitations, and the machinery and software required for each. Examples within aerospace, commercial and industrial market segments will be presented.

- Filament Winding:
  - The process – advantages and limitations,
  - Applications – energy (oil and gas applications), thermoplastic winding and recycling,
  - Machinery – style, axes, mandrels, accessories,
  - Software - pattern development software and design software,
- Automated Fiber Placement:
  - The process – advantages and disadvantages,
  - Applications – energy (wind power applications)
  - Machinery and software
- Choosing the right process - technical issues, costs and throughput

**2:00 PM – 5:00 PM**

***Energy and Recycling Composites Applications: Materials, Applications, Markets***

Dr. Scott Beckwith, BTG Composites, Taylorsville, UT

This is a new tutorial with its primary focus on advanced composites and FRP composites needs, trends and applications within the various markets that are concentrating on energy and recycling. The intent of this tutorial is to provide the attendee with an understanding of what markets will offer composite material opportunities as we strive to find alternate fuels and energy resources while exploring current resources to expanded limits. The approach in this new offering will be to identify the various market segments (oil and gas, wind energy, alternate fuels, hydrogen fuel, etc.) and to provide examples of materials, structures and applications that will allow near-term and future growth. Recycling aspects as they pertain to applications within the energy arena and future concerns will also be presented. Some of the topics covered will be:

- Market overview of several critical energy-related areas,
- Overview of materials and processes being utilized in these areas today,

- Natural fibers, resins and interests outside of “advanced composites”,  
and,
- Recycling – use of recycled materials and future regulatory issues