PAPER ABSTRACTS GLOBAL PULTRUSION CONFERENCE BALTIMORE JUNE 7-8, 2007

KEYNOTE ADDRESS IN HONOUR OF THE LATE STEVEN LOUD

Opening and Welcome.
Speaker to be proposed.

This Key-note should have a relationship between Composite Profile Technology and Application and Energy Technology.

PROPOSALS MADE FOR FOR KEYNOTE SPEAKERS:

1. Prof. Dr. Su Su Wang	University of Houston	Composite technology in Offshore
2. Prof. Geoff Gibson	University of Newcastle	Composite technology in Offshore
3. Prof. Andreas Echtermeier	Norsk Veritas/NTNU	Specialist Composites in Fire
4. Prof. Brian Skeels	Technical Director FMC, Houston, Composite in Offshore	

Awaiting more proposals from Members of the Conference Committee.

CONFERENCE THEME SESSION – ENERGY SAVING

THE CARBON AND ENERGY INTENSETY OF COMPOSITE APPLICATIONS

Professor Timothy Gutowski, Mr. Young Seok Song, MIT

In this paper, we investigated the life cycle energy use, and carbon emissions of composite parts made of different materials, i.e., glass fiber/polyester and carbon fiber/epoxy, and by different manufacturing techniques including pultrusion, autoclave processing, and liquid composite molding. The study includes four phases in the Life Cycle;
1) the materials production phase,
2) the manufacturing phase,
3) the use phase, and
4) the end of life phase.
The evaluation of the use phase requires specific applications in order to determine the performance of the composites and to compare them with other materials options. Two case studies were carried out: one is pultruded glass fiber/unsaturated polyester system which has the potential for replacing steel or aluminum panels used for trucks and the other is carbon fiber/epoxy composite system employed in the aerospace field.

PULTRUDED COMPOSITES - THE CASE AGAINST EXTRUSIONS FOR ENERGY CONSERVATION

Mr. Jeff Martin, Martin Pultrusion Group Inc, Twinsburg OH, USA

Pultruded composite profiles provide the best energy conservation of any material when used to make window and door components. Composite profiles have the lowest coefficient of thermal expansion of any window framing material. This feature means that windows and doors made from composites have the lowest air and water infiltration, making them the most energy efficient windows on the market.
Aluminum extrusions consume large amounts of energy during their processing. Composite profiles are showing signs of increased competition with aluminum because of its lighter weight and the fact that designers can consolidate parts more readily with pultruded profiles.
This paper will explore applications like windows, where composite profiles are providing better energy conservation when compared to extruded materials.

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ACADEMIC AND RESEARCH SESSION

DAMPING EFFECT IN STRUCTURAL PULTRUDED PROFILES

Prof. Salvatore Russo, Universita IUAV di Venezia, Italy

This research shows the first results on natural frequencies and modal shapes analysis vibration of structural elements GFRP (Glass Fiber Reinforced Polymer) pultruded profiles with different cross section. The goal is to know and to examine the behaviour of this kind of elements in terms of free vibration.
In the first phase were investigated the natural vibrations of the flexural plane of two profile with different section, closed box and symmetric open section, with different length and different boundary condition, hinge-hinge and fully clamped. For the clamped-clamped configuration we considered the influence of axial load, applied on profile to realized the restrain condition. For every profile and for every static scheme was analyzed the dynamic behaviour for both principal stiffness axis, I_{xx} and I_{yy}.
The experimental results were verified with the values obtained by numerical and FEM analysis and subsequently compared with the traditional materials behaviour, which wood and steel, that were analyzed with the same static scheme but with the optimized section.
These first results show a negligible difference between the experimental and theoretic values, Ref. [1]; the comparison with the traditional material, instead, highlights a better dynamic answer of wood for the higher deformability of material and an interesting behaviour of pultruded structural element considering the real performance characteristics.

ASCE (American Society of Civil Engineers) DESIGN MANUAL ON FRP PULTRUDED JOINTS

Professor Ayman Mosallam, Phd. P.E., University of California, Irvine, USA

ABSTRACT TO BE SUBMITTED.

RAW MATERIALS DEVELOPMENT SESSION

POLYURETHANE PULTRUSION APPLICATION SUCCESSES WITH LARGE PROFILES

Mr. Joseph E. Sumerak and Dustin Troutman,
Creative Putrusions, Inc., Alum Bank, PA, USA

Polyurethane resin technology for pultrusion was first introduced in the late 1990's as an option that promoted elimination of continuous strand mat due to the exceptional strength and toughness of the resin matrix. All-roving reinforced pultrusions using low pressure injection or low volume wet out boxes was the initial focus for most pultruders pursuing this opportunity. With moderate effort and guidance of the raw material supplier's, success could be realized in fairly short order for small scale profiles. However, the challenges of reactive polyurethane processing of large heavy wall profiles of considerable complexity required considerably more development effort. This paper describes commercial successes at Creative Pultrusions with applications enabled by the superior performance of polyurethane composites.

THIS PAPER IS CANCELLED AS PER MARCH 23, 2007

PULTRUSION OF UNIQUELY DAMAGE-RESISTANT TUBES WITH >100% STRAIN TO FAILURE POLYURETHANE MATRIX MATERIALS

Dr. Jerome P. Fanucci, Richard Balonis, Dr. Mark Snyder, Robert DaSilva
KaZaK Composites, Inc. Woburn, MA, USA

KaZaK Composites has developed pultrusion-based technology capable of producing tubular structures from a combination of extremely high strain to failure polyurethane and conventional composite stiffeners. These tubes can cost-effectively replace steel in many damage-sensitive applications. These novel pultruded tubes display a uniquely small tip deflection up to some pre-determined activation load. Once this design load is exceeded, the tube elastically buckles from round to a nearly flat section. In its post-buckled state, the tube dramatically changes its bending stiffness and becomes capable of undergoing multiple 90-degree flexures. When the load is removed, the tube returns undamaged to its original stiff, vertical position. This paper will

descriptions of use of these high performance pultruded structures on military ships and commercial applications.

WEIGHT AND STRENGTH ADVANTAGES FROM PULTRUDED FIBER ARCHITECTURE

Mr. Todd Johnson, Ebert Composites, California, USA

The earliest pultrusion machine from the world's founder of the process, W. Brandt Goldsworthy, ran solid rod profiles using 100% fiberglass rovings. These, of course, were the natural reinforcements to start out with, given the times. When Brandt received the first roll of rovings on the West Coast of the US from Owens Corning, circa 1938, he started to think right away, that there must be a way to process this with resin in an automatic machine. Later, he made that vision come true.

But then as the industry evolved, it became obvious that the low interlaminar strength of the solid , unidirectional profiles needed cross directional reinforcement. Thus evolved the material of choice: continuous strand mat. It is easy to work with, has great forgiveness, and many pultruders today still use this tried and true combination. However, as has been shown, there really is no reason to not pultrude with even a broader array of fabrics, from stitched, to woven, and even 3-dimensional.

As the fiber architecture is expanded, there is an efficiency gain in the composite. This means there can be less material required to meet the loading requirements; this efficiency gain means the composite can weigh less and in the transportation industry, lower weight translates to improved fuel consumption. In today's reality of high oil costs; materials, products, and transportation systems as a whole need to shed the extra weight to conserve energy. In our current energy and weight conscious time, W. Brant Goldsworthy, would want the industry to understand that reinforced laminate material choice must be dictated by the end-product need to reduce weight and increase strength in the most efficient methods available to the pultruder. Thus the easiest materials to pultrude---roving and continuous strand mat---may not be the best from an energy-consumption viewpoint.

CONVERSION FROM BASALT INTO ANDESITE-BASALT AND ANDESITE – THE WAY OF DRASTIC DEVELOPMENT AND THE QUALITY OF THE WHOLENESS FIBER

Prof. Roman Verulashvili, Fiber VER. Co., Tbilisi, Republic Georgia

Speaker: Mrs. Yali Zhang, Shanxi Yaxin Coal Coking Co. Ltd., Quingxu County, China

The achievement made by the basalt continues fiber factory made us believe that the basalt fiber can satisfy the demands of different fields such as mobile, energy, road building, chemical engineering and military services, etc., which turend out to be a new material and aroused much attention from all over the world in the recent decade.. However thre are many elements restraining the development of basalt fiber industry., such as high concentration of iron, leading to uneven processing temperatures and creating problems with the platinum bushings. The solution to this problem has been found by using andesite to replace basalt. Two patents on this technology have been issued in Georgia and are now applied by Shanxi Yaxin Coal Coking Gas Company, a strong Chinees company to develop a new technological solution by using cooking gas instead of natural gas with andisit to produce an new and low cost high quality continues fiber for pultrusion applications amongst others.

PROCESSING TECHNOLOGY SESSION

PULCAT, 10 YEARS LATER

Mr. Dennis Fink, Norac Inc., USA

10 years ago a new organic peroxide cure initiator "Pulcat" was introduced by NORAC to the pultrusion industry. A review is made of product use in case histories. Major advantage of the Pulcat has proven to offer: faster line speeds, better surface profile, more safety in storage and handling, while actually being less expensive. In an era when our industry needs to be concerned about emissions, Pulcat is a readily soluble liquid that lends itself easily to direct dye injection. Pulcat is best used for increasing line speeds while producing "Class A" surface finishes. In combination with BPO it is an effective initiator for thick cross sectional profiles. The initiator is also suitable for non-

IMPACT OF THE AXIAL LOCATION OF THE INJECTION SLOT FOR HIGH SPEED RESIN INJECTION PULTRUSION

Mr. A.L. Jeswani, J.A. Roux and Prof. J.G. Vaughan.
Dept of Mechanical Engineering, University of Mississippi, USA

Resin Injection Pultrusion (RIP) is a continues process and one of the most cost effective methods for manufacturing composites with constant cross sections. However, the complete wetout of the dry reinforcement by the liquid resin depends on various design and process parameters. The design parameter studied her was the axial location of the injection slot from the injection chamber inlet for high pull speed (0.0508 m/s (120 in/min) resin injection pultrusion. A 3-D finite volume technique was developed in this study to model the advance of the liquid resin flow front through the fiber reinforcement in the resin injection pultrusion process. The objective was to improve fiber reinforcement wetout, and thus, the quality of the pultruded part. The numerical model simulates the flow of liquid resin through rovings and predicts the impact of the injection slot location on the fiber reinforcement wetout, the resin pressure field, and the resin velocity field. The location of the steady state liquid resin flow front was predicted for an injection slot located at different axial locations for a tapered-wall resin injection chamber.

PRODUCT INNOVATION SESSION

ONE PROCESS – LOW COST - HIGH STRENGTH – FOAMCORE PRULTRUSION

Mr. Andrew Rekret, Mastercore Systems Ltd. Canada

Multiple profile composite parts of polyurethane pultruded skins with a foam core have become a reality. This paper is an overview of developments that allow polyurethane pultrusion to be used for numerous applications. The paper will review the process, chemistry, and some of the specific requirements necessary to produce complex profile parts in one pultrusion system. It will also draw comparisons between the Mastercore Process (“MP”) produced parts and other materials: carbon, titanium and aluminum.

FULL PULTRUDED FRP PROFILE STRUCTURES

Mrs. Dr. M. Dolores G. Pulido. Civil Engineer, MSc, Pedelta, Spain

Over the last decade there has been significant growth in the use of FRP composite materials as construction materials in structural engineering. These materials have proven themselves to be valuable for use in the construction of new buildings and bridges and for the upgrading of existing structures thanks to its lightness, minimum maintenance costs, execution easiness, corrosion resistance, durability, high specific strength, no magnetic interaction, etc.
In the paper, several full pultruded FRP structures are presented: *two pedestrian bridges* located in Spain -one of them (Lérida footbridge) was built to cross a railway line and the new projected high-speed railway line between Madrid and Barcelona and the other one is located inside a cave-; *the Façade of the Conference Center of Badajoz*, also in Spain, an outstanding example of an elegant public building integrated into a consolidated urban area, where the main building has a circular layout and is surrounded by an external façade – like a big fence- made of GFRP profiles; *a truck truss bridge* in Colombia for emergency situations (under design) and a number of *bridges strengthened* using FRP laminates. General description, requirements, design criteria, analysis structural, construction and conclusions of all the structures will be described in the full paper.

MARKET DEVELOPMENTS AND CASE STORIES

TRENDS IN THE NORTH AMERICAN PULTRUSION MARKETS AND BENEFITS OF THE LRFD STANDARD

Mr. John Busel, Pultrusion Industry Council of the ACMA, USA.

ABSTRACT TO BE SUBMITTED.

THE INDIAN PULTRUSION MARKET

Mr. S. Venkatachalam, Sintex, India

The Indian economy is growing at a rapid rate of over 9.0%. There is a boom in the Construction and Transportation (Railways) sectors. Such growth provides huge opportunities for various types of composite manufacturing processes, especially Pultrusion. Apart from this, there is a significant growth in Automotive and Telecom sectors which also provide further opportunities for Composites.
Sintex Industries Limited is one of the largest manufacturers of SMC and Pultruded products with supplies to the Electrical (Meter Boxes, Cable Trays etc.), Railways and is also a large exporter of finished composite products. With significantly lower labour costs, India provides an excellent opportunity for outsourcing / off-shoring various plastic and composite products

CHALLENGES FOR THE RUSSIAN PULTRUSION INDUSTRY

Prof. Andrey Ushakov, ApATeCh-Dubna, Moscow, Russian Federation

The problems, which exist nowadays in bridge management of Moscow city megapolis have been described. The ways of solving of these problems with help of applying of composite materials have been proposed. Realized and planned objects, including small pedestrian bridges, collapsible bridges, pedestrian decks, motor-car bridges, drainage elements and others.

Cost-effectiveness of FRP applying in megapolis conditions. Creation of normative base for FRP applying in bridge construction. Experimental determination of parameters of static, fatigue and timeproof durability, parameters of crack growth resistance of material of pultrusion profiles taking into account the climatic factors and also static and fatigue resistance of bolted connections.

CLOSING SESSION - CONFERENCE ROUND UP

HOW I SEE THE FUTURE OF PULTRUDED MATERIALS IN CIVIL AND OTHER STRUCTURAL ENGINEERING APPLICATIONS

Mr. Jaap H. Ketel, Ketel, COBRAE, Leusden, The Netherlands

All structural materials need energy to make them suitable for constructions. Even if they are taken direct from nature, such as wood, stone, or clay for bricks. When the cost of energy rises, which no one doubts it will do further in the coming decades, it is obvious that low energy containing structural materials will become more competitive in time. The role of composites, especially pultruded composites, will therefore grow in future and become more important in civil and structural engineering. An analysis is made in which areas and applications substantial growth can be expected in future so pultrusion companies can prepare themselves for making long term strategic investments. Typical examples of pultrusion applications ready for market growth are given to support these arguments.

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PULTRUSION INNOVATIONS SESSION - LICENSING & TECHNOLOGY EXCHANGE

Delegate Representatives of Pultrusion Engineering and Production Companies from around the world give a 3 minutes maximum presentation on technologies related to pultrusion materials, machines, products and applications. Object is to find potential licensee partners in other geographical areas by exchanging innovative idea's in order to grow applications and markets for the Global Pultrusion Industry. *Pre-registration required by E-mail: info@briskevents.nl*

REGISTERED 3 MINUTES PRESENTATIONS (maximum 10)

NO.	PRESENTER	PRODUCT/TECHNOLOGY	PATENT STATUS
1.	Prof. Sung Woo Lee	Delta Deck bridge deck with snap-fit connection	Worldwide