MARCH 2017

AZL AACHEN
EXCELLENCE IN LIGHTWEIGHT PRODUCTION
PARTNERSHIP

NEWSLIGHT #08

NEWSPAPER FROM THE INTERNATIONAL AZL LIGHTWEIGHT PARTNER NETWORK

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COMMENT BY PORTIA YARBOROUGH

COMPOSITES WEB: SPURRING INNOVATION

DuPont Performance Materials outlines the potential of high volume thermoplastic composite solutions and presents the results of recent innovations enabled by its Vizilon® thermoplastic composite offering

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Driving new ideas, developing innovative solutions and meeting the latest standards comes down to one thing: making the right connections. Because there are no one-size-fits-all answers, DuPont works hand-in-hand with our customers to help them find optimal solutions to their specific needs. Among the biggest challenges facing many industries is how to reduce environmental impact while continuing to deliver quality products. A case in point is the automotive sector, with the focus on light weighting solutions that reduce carbon dioxide emissions without compromising performance.

The key to innovations lies in identifying the right mix of different technologies and expertise

Portia Yarborough, Business Manager – Composites at DuPont Performance Materials

Multi-Material Design Approach –
No single material can help them achieve this goal – which is why holistic thinking and collaboration along the value chain is so important. It requires a multi-material design approach that supports material optimization by using the right material in the right place to achieve performance improvements, weight savings and cost reductions all at once.
In this regard, we see significant potential in the use of thermoplastic composites (TPC). They allow automakers to integrate lightweight materials selectively in specific areas of a vehicle. Vizilon® TPC is a growing family of thermoplastic composites solutions within the DuPont product portfolio. Our existing capabilities and enabling technologies, including predictive engineering, help us to continue to validate our Vizilon® TPC offering and develop tailored solutions by pooling expertise with partners in the value chain.
An example of a successful collaboration in this area is our work with EconCore N.V. on the development of thermoplastic composite based honeycomb sandwich panels. Combining EconCore's ThermHex technology with DuPont™ Vizilon®, this partnership has given shape to ultra-light sandwich panels that directly meet the needs of customers in sectors such as automotive, construction, leisure and energy. The panels demonstrate that strength, flatness and high rigidity can go hand in hand with lightweight and high-volume applications.

The key to innovations such as these lies in identifying the right mix of expertise, materials innovation, design, processing, and assembly techniques along the value chain. **AS AN AZL-PREMIUM PARTNER, DuPont values the centre's unique platform for engagement with different sectors and experts working at the cutting-edge of research.** This is why we co-located our research activities at AZL in 2016 with a view to matching market needs with commercially viable innovations. DuPont's on-going commitment to investing in innovation and future technologies is based on precisely these types of connections.
Learn more about DuPont's partnerships and innovations at Pavilion 5A, Stand E24 during JEC World 2017, 14-17 March or by visiting vizilon.dupont.com

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UNIQUE AND INNOVATIVE BUILDING FAÇADE SYSTEM

Construction company TGM collaborated with Indupol, Aliancys, BÜFA and Solico to create novel construction technologies and a great composite façade project example with a unique shape and design.

TGM is a Dutch construction company specialized in the installation of building façade systems. Over the years the company has been acting as subcontractor in multiple construction consortia in the Netherlands, completing a large number of office and residential buildings in the high end of the market.

Novel composite façade solution of the new Eurojust office building in The Hague, Netherlands.

Typically TGM is installing a complete façade solution onto the bare concrete building. This façade assembly includes structural components, insulation to heat and moisture, ingress protection, as well as elements that provide aesthetics.
Unique Design – Architects have been asking TGM for help to create buildings with unique and distinctive looks. For that reason, a solution based on composites seemed logical, as that provides architects with high flexibility to create novel shapes and designs. In addition, it brings to the building owner the interesting benefits of long service life and minimal maintenance.
A novel composite façade solution was first developed for the construction of the new Eurojust office building in The Hague, Netherlands. This project required the delivery of over 700 façade panels of multiple widths and lengths (ranging from 3.5 to 10 m).
Changing Requirements – Right from the start TGM involved composites design company Solico, resin suppliers Aliancys and BÜFA, and component manufacturer Indupol to develop the composite system and a reliable process for large-scale production. After having gone through several design iterations, the companies developed a compact proprietary composite system that met all the requirements. As an illustration: a mock-up of the assembly successfully passed fire testing and a real-life and very harsh mechanical attack by experienced vandals.
Smooth Productions and Installation – The composite components were made by Indupol through a hand lay-up process in modular molds that were adjusted to the desired shape and dimensions, using resin from Aliancys and Büfa (delivered through Distributor Euroresins). After molding, the parts were treated with a topcoat in white color and transported to the job site for installation. With minimal use of scaffolding, the parts were lifted by a crane and attached onto the building.

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From left to right: Michael Effing, Senior Advisor, Michael Emonts, Managing Director, Kai Fischer, Managing Director

EDITORIAL

DEAR READERS

Welcome to our first paper edition of the AZL NewsLIGHT – the newsletter of the international AZL Lightweight Network. Since its foundation, the AZL Network has grown steadily: Having started with 35 founding companies in 2013, the network today counts more than 80 Partner Companies from 20 countries, such as the USA, Korea, Japan, China, Mexico and numerous European countries. Our 9 Partner Research Institutes of the RWTH Aachen are all located on one of Europe's biggest research landscape: the RWTH Aachen Campus.

NewsLIGHT offers you an exclusive overview of the individual and joint activities of this broad network. Insights into composite market development and political activities complete the picture of the international lightweight landscape.

We look forward to the year ahead with new activities: With our relocation to the brand-new Production Engineering Cluster on the RWTH Aachen Campus, we put our additional large-scale equipment into operation. Our Partners will have access to shared and individual offices working shoulder to shoulder to brains and hardware of our inspiring environment at RWTH Aachen University. Among the new activities, is our new concept of "Joint Business Development" defined together with the AZL Partners: In B2B Networking Events and joint company visits, we will address new markets and regions for lightweight technologies.

In 2017, we will continue with our joint R&D activities. Our industrial workgroups meet regularly for technology-related networking, to identify pre-competitive R&D topics and projects. You find updates on AZL workgroups in this NewsLIGHT paper edition. A major project will be the Joint Market and Technology Study "New Potentials for Composite Technologies in Buildings and Infrastructure", started in 2016. The study involves AZL Partner Companies and participants from outside the AZL network to identify new business opportunities for composites in the growing Buildings & Infrastructure markets.

Enjoy reading and contact us or our Partner Companies and Institutes with your ideas and requests.

Sincerely

Kai Fischer
Michael Emonts
Michael Effing

AXIA MATERIALS LAUNCHES PIXEL HAUS®

A NEW WAY OF HOUSE CONSTRUCTION WITH COMPOSITE PANEL

Axia Materials, located in South Korea, entered into new business discussions in various countries including Americas, northern Europe and middle east countries.

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Axia Materials, the development specialist and provider of composite material announced the launch of Pixel Haus®, the brand for house construction solution with composite panels. Axia Materials (www.litetex.com), locating in South Korea, is one of the world's leading thermoplastic composite material and solution provider, specialized in high strength and lightweight composites for weight reduction applications in automotive, aircraft, military & defense, electronics and construction industries. Based on the accumulated composite technologies and experience of supplying composites to US military construction project, the company recently completed the development of a new construction solution to build houses with composite sandwich panels and branded it as Pixel Haus®. Axia Materials is strengthening its global presence in construction industry along with various contract discussions for new business and investment opportunities in USA, Sweden, Norway, Denmark, Italy, UAE, Saudi Arabia and many other countries.

Installation of Pixel Haus® – House construction solution with composite panels

The Pixel Haus® – easy assembly of Composite Panels

The Pixel Haus® uses Axia Materials' unique continuous fiber reinforced thermoplastic composites, LiteTex®, and composite sandwich panel, LitePan®, which is made of LiteTex® with various insulating foam cores. The Pixel Haus® has innovative and differentiating points compared to existing construction method. The core material of Pixel Haus®, LitePan® is composite SIP (Structural Insulating Panel), which has structure, insulation, waterproof, and corrosion resistant functions simultaneously, and the dimension of one panel is up to 2.7m x 12.0m. Owing to the lightweight and size, it is possible to complete construction by simple assembly of the panels in a short period. The actual constructions including interior and exterior finishes in Germany, USA, Sweden and Korea have been completed less a week. Despite the short period, its structural and finishing performance showed as same as conventional construction method.

The insulation performance of Pixel Haus® is very high because thermal bridges are eliminated. In case of 110m² completed house, the heating cost was recorded under 12 Euros per month in winter season. And, when considering a SIP house, the fireproof is one of essential factors for safety. LitePan® got 1 hour of loadbearing fireproof certificates in USA, Sweden and Korea. Additionally, the Pixel Haus® is eco-friendly and green construction solution. LiteTex® has zero VOC (Volatile Organic Compounds) emission, and during the Pixel Haus® construction, there are less noise, dust, and dry process uses no water. Most of Pixel Haus® materials are fully recyclable, and the production of composites use only 15% of the energy that is used for production of fabricated steel.

Justin Jin, CEO of Axia Materials said, "The Pixel Haus® solution is the perfect fit for today's highly demanding requirements for insulation, energy efficiency, eco-friendliness, sustainable, and cost and labor savings globally.", and he finally emphasized that "We are under in-depth discussion with several partners to build fully automated plants in strategic countries and strongly believe our solution will help many people to enjoy better quality of life with less budget and time investment.". "Pixel Haus® is not only for high-end energy saving homes but also for affordable home solutions for emerging countries. This technology will enable the local people to build their own homes by themselves in DIY way as well."

THE FUTURE OF BUILDING

The growing use of Composites in Construction

ANDREW MAFELD | CONNECTRA | ANDREW.MAFELD@CONNECTRA.BIZ

The Paris based JEC Group, whose mission is to provide knowledge and networking opportunities for the composites industry worldwide, is publishing a new study of the use of composites in construction. The study looks at eighty-two examples of the use of composites across a very wide range of building applications around the world.

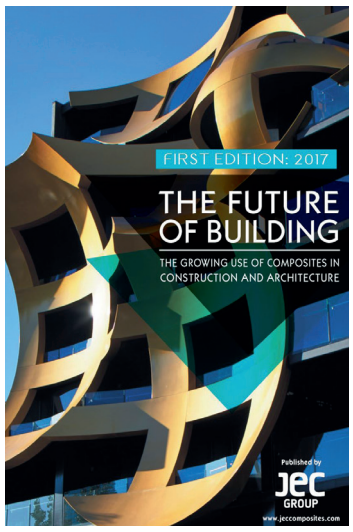
To do justice to these applications, a much wider definition of composites has to be used, one which encompasses a wider range of matrices than just polymers e.g. gypsum, cement or concrete and a broader range of reinforcements than just glass and carbon fibre e.g. natural fibres and steel fibres.

The first area which is looked at in detail is the use of composites in architectural projects, of which there have been a growing number in the last three years. Many of the world's leading architect firms have discovered how composites can turn architects' designs into a reality which cannot be achieved with other materials. Light weight and freedom of form are the two key reasons for this choice of composites. In total twenty-one reasons have been identified as driving the growing uses of composites.

The second area examined is the use of composite systems in the construction of either the whole building or significant parts of buildings e.g. floor, walls and roofs. There are large existing applications as well as fast developing new ones such as pre-cast concrete walls reinforced with carbon fibre grid.

The third area covered is that of composite elements e.g. doors, window frames, modular shower rooms. Composite moulders have developed a wide range of solutions for the building industry.

Finally, the use of composites for the reinforcement and repair of buildings is examined. Additionally, a number of trends positively impacting the growth of composites are reviewed. Altogether the future for composites in building looks very positive.



The study will be available to purchase at the JEC 2017 or via the JEC web site. For further details please contact Mr. Mafeld, Managing Director of Connectra Global, and Anne-Carole Barbarin, Development Director at JEC Group, barbarin@jeccompostes.com.

LAST CHANCE TO JOIN STUDY ON BUILDINGS AND INFRASTRUCTURE!

The 6-month study "New Potentials for Composite Technologies in Buildings and Infrastructure" focuses on the growing markets Buildings and Infrastructure and comprises application analyses of 12 market segments, investigation of 100 applications, technology analyses of 25 highlight components and 10 detailed business cases. More than 25 companies joined already. For more information follow www.azl-aachen-gmbh.de

MARCH 22

The first report meeting will be on March 22nd, 2017. Take your last chance and join!

INTERVIEW

» The development of lightweight components for the automotive industry is of highest priority.

Lothar Gräbener
Vice President Sales I Schuler Pressen GmbH
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With a broad range of production equipment, Schuler addresses various industries – in the first place for the automotive mass production. For NewsLIGHT, Lothar Gräbener, Vice President Sales of Schuler Presse GmbH, provides insight into the automotive composites market, and the Asian and US market development for composites.

AZL: How do you regard the relevance and development of lightweight for the automotive sector?

Lothar Gräbener: The global commitment to environmental protection of almost all major industrial nations has resulted in ambitious goals to reduce the CO2 emission of motor vehicles. OEM´s are compelled to bring down their fleet consumption drastically in the period of 2020 to 2025 in order to avoid costly penalties.

Numerous initiatives and innovations have been launched in this respect. All OEMs are required to present hybrid and electric vehicles in the near future to meet the stringent emission targets. Regardless of the drive concept, it is mandatory to reduce the vehicle's weight.

Less consumption of fuel or battery energy and less CO2 emission is the challenge. The rising environmental awareness of customers will have an impact on the market shares. Only clever and economical solutions with sufficient reach can be marketed successfully. Therefore the development of lightweight components for the automotive industry is of highest priority.

Which production processes will play a major role in the future serial production of lightweight components?

Currently a multi-material mix is being used in lightweight vehicle designs. Various materials for lightweight components are available: High strength steels (HSS), aluminum, fiber reinforced plastics and hybrid materials. The corresponding manufacturing processes have been established: The hot stamping process for HSS and aluminum, the hydroforming process for tubular structures and the HP RTM, wet molding and SMC processes for fiber reinforced plastics which can be combined to make hybrid structures.

Over the last years, the hot stamping technology has experienced tremendous growth. In the field of composites, the growth has been rather moderate. In the future, we see a high potential for hybrid parts as they combine various advantages.

How will the composites market develop over the next 3 years?

We confirm the findings of the actual composite market survey by the VDMA. According to the survey, all member companies have estimated the current business situation as generally positive. In the forecast for the major economic regions relating to the second half of 2017, the highest growth rate is expected in Asia for the first time. With a continued positive investment climate, the composite index shows a strong upward trend.

Among the main growth drivers, the automotive and aerospace sectors are those where the highest growth impetus is being anticipated. CFK (carbon fiber reinforced plastics) still is the growth driver no. 1. With the development of the new multi-functional composite press, the close collaboration with the leading European institutions and research institutes (AZL, NCC), USA (IACMI) and the Composites Alliance with the company FRIMO, Schuler has established the prerequisites to participate in the growing market.

Which developments do you monitor for the Asian and north American market?

The major incentives are coming from Asia, followed by Germany and the USA. The Institute for Advanced Composites Manufacturing Innovation (IACM) is a lighthouse project in the USA supported by the Department of Energy. Likewise, a Korean OEM relies on an innovative short-stroke press concept to develop composite parts for the Asian market. It is noticeable that various facilities are operating in the fields of research and process development in the Asian and North American markets, however, contrary to Germany, so far none of the applications has gone into serial production.

From your point of view, what is the major impact of shoulder to shoulder cooperation and Open Innovation?

We see an advantage in the collaboration with institutions, research institutes and specialized suppliers in the supply chain. Schuler has already entered into several cooperation projects. We are collaborating with the AZL in Aachen regarding the development of process technology for future applications. In 2017, the institute will start up an 18.000 kN multi-functional composite press that will be used also in the research project of iComposites 4.0, a public funded BMBF project together with e.g. Frimo, AZL, Siemens, Toho Tenax. The Composite Alliance set up with the company FRIMO enables Schuler to supply turnkey systems for composite manufacturing processes.

PILOT PRODUCTION

NEW SCHULER PRESS SYSTEM AT AZL

At the new AZL machinery hall in the Production Egineering Cluster at the RWTH Aachen Campus, AZL's Composite Press System with a table size of 1.8 m x 2.8 m and a tonnage of 1.800 tons is currently installed. The Schuler press system will be available for your pilot production soon. For details please contact Mr. Richard Schares from AZL at RWTH Aachen University: Richard.Schares@azl.rwth-aachen.de

Press system available for pilot proudction

PORSCHE 911 GT3 RS REAR APRON INCORPORATING 3M'S GLASS BUBBLES

Minimal density, maximum performance! The rear apron of the Porsche 911 GT3 RS is made out of a Polyurethane using 3M's Glass Bubbles as a lightweight filler. Hence the actual part is 23% lighter compared to its predecessor while maintaining the same mechanical performance and surface quality.

Rear apron of Porsche 911 GT3 RS made of 3M Glass Bubbles

To obtain an astonishing performance at moderate fuel consumption and low emission values, Porsche relies on lightweight materials. The rear apron is composed of a density optimized Polyurethane mixed with 3M's Glass Bubbles and ground carbon fibers.

Lower density than water – The Lightweight material developed by Covestro, Polytec Car Styling and 3M comes along with a density lower than water, reducing the weight of this big part by 23%. Thereby hollow glass microspheres from 3M are used as a functional filler to significantly reduce density. Prior to that the ductile PU elastomer had a density considerably higher than 1.26 g/cc. The cause: The mineral fibers added to increase strength and stiffness negatively impact the average density due to their high density of 2.85 g/cc along with a weight fraction of 17 %.

Weight reduction with 3M Glass Bubbles – The weight reduction of the rear apron is a result of the incorporation of the uniform hollow glass microspheres. Those are made out of a water-insoluble borosilicate glass, featuring low density at an extreme (hydrostatic) pressure resistance. Further the microspheres are combined with ground carbon fibers. The mixture of tiny fibers and spherical Glass Bubbles enables the manufacturing of a Polyurethane part with almost isotropic mechanical properties and high toughness.

Light and dimensional stable – To broaden the field of applications the portfolio of 3M Glass bubbles is screened continuously. The nominal densities of the different types range between 0.125 g/cc and 0.6 g/cc. As a filler for e.g. thermoplastic compounds, 3M Glass Bubbles enable the reduction of the specific weight of a part up to 25%. Thereby it's possible to efficiently produce lighter plastic parts with high dimensional stability and surface quality.

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POLITICAL INSIGHT

LIGHTWEIGHT CONSTRUCTION – ACTIVITIES OF THE GERMAN FEDERAL MINISTRY FOR ECONOMIC AFFAIRS AND ENERGY

In order to maintain Germany as a global leader in terms of manufacturing, developing production technologies and innovative materials, we must seize the opportunities of lightweight construction and actively look for solutions to tackle challenges such as recycling concepts for composites or the high energy demand in the production of specific materials. Only holistic concepts can contribute to modernising and strengthening a sustainable industrial base.

The Federal Ministry for Economic Affairs and Energy promotes lightweight construction as an innovation technology by means of the following measures:

The lightweight construction atlas – The "lightweight construction atlas" (www.leichtbauatlas.de) is an interactive portal which illustrates the lightweight-construction- related skills in Germany – for all materials, technologies and sectors. Organisations can present their processes and activities on this website. The atlas helps in particular enterprises and research institutions to find local lightweight-construction solutions that meet their needs. For this purpose, a catalogue comprising around 250 criteria has been elaborated in close cooperation with business and academia for the targeted search for suppliers and partners. A search tool and a map of Germany serve as additional instruments. I would like to encourage you to seize this opportunity and to present your company with its skills on this platform. The innovative potential of your sector and our support contribute to strengthening Germany's industrial base in the long term.

Werner Loscheider
Head of Division IVB4 I Federal Ministry for Economic Affairs and Energy
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Lightweight construction office – In the coming months, the lightweight construction office will start its work on behalf of the Federal Ministry for Economic Affairs and Energy. It is to serve as a national and international hub for lightweight construction and to help German companies, especially SMEs.

Round table "lightweight construction forum" – The Federal Ministry for Economic Affairs and Energy organises a round table on lightweight construction every six months. The forum serves primarily to share knowledge and establish contacts. It provides the possibility to present and discuss recent technological trends, the work of the Federal Ministries, and opportunities and challenges at national level and on foreign markets.

Study on employment effects – This study is to identify – by using the example of the automotive industry – the lightweightconstruction- specific need for action in the fields of education and training, and options for specific action. The findings of the study are to be presented in the context of an industrial policy dialogue in 2017/2018.

Lightweight construction in numerous funding programmes – Apart from these specific support instruments, lightweight construction is part of numerous funding programmes of the Federal Ministry for Economic Affairs and Energy. These include the technologyneutral Central Innovation Programme for SMEs (ZIM), the Industrial Collective Research (IGF) programme, and funding programmes for the aerospace sector, the automotive industry and the railway sector.

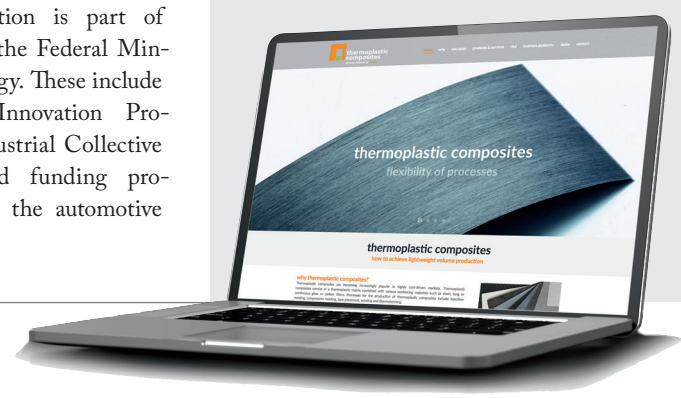
BUSINESS PLATFORMS

The recently launched Business Platforms provide technology-related information, established suppliers as well as innovative development partners for various lightweight technologies.

Visit the lightweight technology websites for an easy entry into: Thermoplastic Composites and High-Speed RTM

With background information and use cases for each technology as well as an overview of products and services, these websites inform on existing solutions and function as a one-stop-shop to find suppliers and partners along the entire value chain. The websites are jointly built up by the AZL Partner Companies representing the entire value chain of lightweight production. In 2017, Business Platforms for High-Performance SMC and Composite Pipes and Vessels will be launched.

>> tp-composites.com
>> high-speed-rtm.com



RESEARCH INSIGHT

STRUCTURAL HEALTH MONITORING – AN INTERDISCIPLINARY APPROACH

The Institute of Structural Mechanics and Lightweight Design (SLA) initiated an interdisciplinary consortium for Structural Health Monitoring to achieve low system cost. The holistic approach is demonstrated for a thin-walled drive shaft. The results are going to be presented at an industry workshop in fall 2017.

ANDREAS PREISLER I SLA AT RWTH AACHEN UNIVERSITY ANDREAS.PREISLER@SLA.RWTH-AACHEN.DE

Within the last decades, lightweight design has evolved to an advanced state, leading to highly optimised structures used to capacity. If those structures are damaged due to fatigue or accidental events (e.g. impacts), damage progression has to be considered. Hence, it is essential to detect damages during the uncritical stage, leading to high monitoring effort (e.g. performing regular inspections).

Structural Health Monitoring (SHM) is the automatic in service monitoring of structural condition. It is a tool to guarantee structural integrity, while reducing the amount of inspections. Since there are various obstacles, successful SHM needs a holistic and interdisciplinary approach. It is not sufficient just to attach a sensor to a highly stressed region of the structure. Recorded data need to be transmitted, processed and evaluated. Therefore, the system needs an innovative power supply, e.g. achieved by energy harvesting. In addition, sensor application during the manufacturing process of the structure should be considered. For example, integration of the sensor within two different layers of composite materials is beneficial since it leads to a protected sensor. Deepened structural analyses provides data for optimizing sensor position with respect to sensor sensitivity.

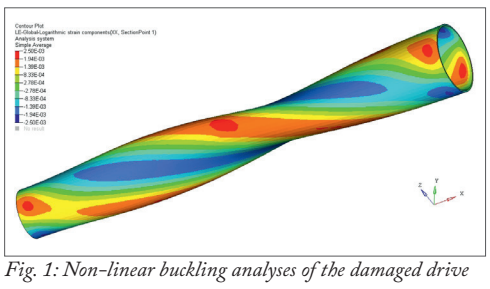


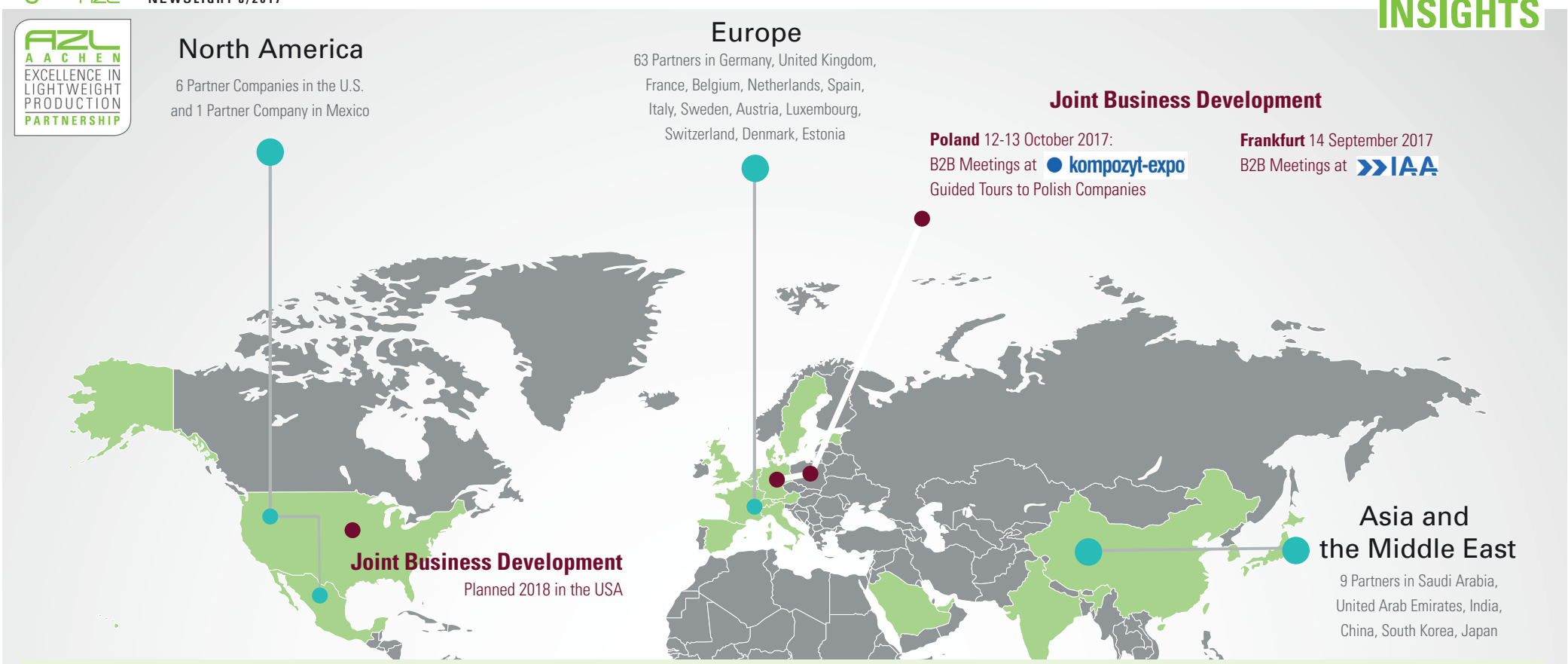
Fig. 1: Non-linear buckling analyses of the damaged drive shaft.

In order to cover all of these aspects, the Institute of Structural Mechanics and Lightweight Design (SLA) founded an interdisciplinary consortium consisting of 14 research institutes of the RWTH Aachen University. A thin-walled drive shaft made out of glass fibre reinforced plastics (GFRP) is chosen as a demonstrator. Due to the low thickness to diameter ratio, torsional buckling limits the load carrying capabilities. An accidental event such as an impact may damage the material and thereby reduce the buckling load.

In order to detect impact damages, fibre optical sensors, produced by the Fraunhofer Institute for Production Technology IPT, are integrated during the braiding process at the Institute of Textile Technology (ITA). Their positions and directions are optimised using numerical analyses (see Fig. 1) at the SLA with respect to sensor sensitivity. The impact damage (see Fig. 2) is introduced at the Institute for Automotive Engineering (ika) by using an impact tower. Static and dynamic tests of the damaged drive shafts are scheduled afterwards at the Institute for Machine Elements and Machine Design (IME). Metallic load introduction sleeves, designed by Institute of Welding and Joining (ISF), are directly joined during braiding process. The Institute of Communication Technologies and Embedded Systems (ICE) investigates the power supply by induction during the dynamic tests.

Fig. 2: Impact test of a GFRP drive shaft.

The results are going to be presented at an industry workshop in fall 2017 at RWTH Aachen University. Please contact Andreas Preisler for further details.



INTERNATIONALIZED LIGHTWEIGHT ENTERING NEW REGIONS AND NEW MARKETS FOR LIGHTWEIGHT AZL PARTNER COMPANIES LAUNCH JOINT BUSINESS DEVELOPMENT

To bring lightweight and composite technologies forward beyond aerospace and automotive sectors and the established regions in central Europe and the USA, new perspectives and broad exploration are needed to uncover the great potential of composites in areas yet to be discovered. In order to jointly address new regions and markets, and develop novel business for lightweight production, the AZL Partner Network has decided to launch a new collaborative model for Joint Business Development. For the first year, Eastern Europe with a focus on Poland was selected to be the region for extended matchmaking. With the entry to the EU, Poland has developed to an increasingly attractive destination for foreign direct investment (FDI) for global companies and has experienced a growth of foreign trade which almost expanded ten-fold. Being an important producer of finished passenger cars and buses, the automotive industry is one of the leading trading sectors in Poland. At the same time, Poland has a history with Glass Fibers and Composites. From October 12th to 13th, AZL Business and Premium partners have the opportunity of participating B2B meetings at the largest Eastern European composite show, Kompozyt Expo 2017 in Kraków, a subsequent networking dinner and guided tours to Polish composite companies.

OCTOBER 12 **B2B Meetings and guided tours**

MARKET INSIGHT

> ***Especially the thermoplastic production technologies as well as the RTM-Technology have gained special interest and an increase in production volume.***

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The AVK (Federation of Reinforced Plastics e.V.) represents the interests of manufacturers and processors of reinforced and filled plastics, engineering thermosets as well as their raw materials suppliers on a national and European scale. **Elmar Witten, Managing Director at AVK** *and* **Volker Mathes, in charge of Business Development at AVK,** *summarize latest trends of the CFRP and GFRP markets drawing on Composites market report 2016 and the results of the 8th Composites market survey of Composites Germany.*

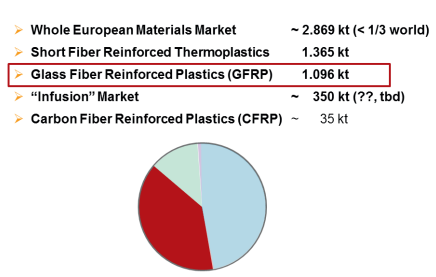
AZL: Can you describe the development of the market for glass fiber reinforced plastics?

Elmar Witten: The worldwide composites market reaches a level of about 9 million tons. Europe's share of global composites production continues to decline – despite its absolute growth in total production over recent years. Processing of commodities (standard products), in particular, has clearly shifted towards Asia and America over this period. In short, GRP production in Europe continues to grow but will probably lag behind the global trend.

How is the market allocation of the different Composites material?

The AVK together with their partners CCeV (Carbon Composites e.V.) and AMAC (Advanced Materials and Consultancy GmbH) collects data concerning the European Composites Market. The following figure refers to this data.

The whole European market reaches a level of about 2.850 kt in 2016. This is a little less than 1/3 of the world production. The biggest single segment in this market is the Short Fiber Reinforced Thermoplastics. They have a share of more than 45% of the complete market. The next bigger group are the GRPs with a volume of 1.096 kt. The term GRP refers to all glass fibre reinforced plastics with a thermoset matrix as well as glass mat reinforced thermoplastics (GMT). The "Infusion" market reaches a level of 350 kt and last but not least CRP had a production volue in Europe of 35 kt. Besides there are other materials like Natural Fiber Reinforced Composites or ceramic composites for example. The GRP market is the market-segment we mention when we typically talk about the GRP-Market.



The European Composites Market. Source: AVK

How is the European GRP-market developing?

Volker Mathes: In 2016, the volume of glass fiber reinforced plastics (GRP) manufactured in the European countries has grown by 2.5%. The market growth continues at the same rate as in 2015. The total production reaches a volume of 1.096 million tons..

Which are the growing sectors in Europe in the composites business?

Elmar Witten: It may not be overseen that GRP products are very often already well established in different markets. This includes single part production as well as serial production in many different application fields. The production volume is many times higher as the CRP-production volume (35 kt Europe 2015) for example.

The largest buyers of GRP components are to be found in the transport and construction sectors. These each consume around one-third of total production and play a major role in national economies. The long-term trend for GRP production therefore tends to follow the growth of the economy as a whole. Nevertheless, no rapid expansion of production (similar to that seen in the CRP segment) is to be expected in the near future. This is partly due to the very considerable level of existing production and also the fact that fluctuations in one industry are usually "smoothed out" by other applications. Especially the thermoplastic production technologies as well as the RTM-Technology have gained special interest and an increase in production volume.

What are the upcoming trends?

Volker Mathes: As the results of the 8th Composites market survey – published by Composites Germany - show the general business situation is largely seen as positive in the composites market. When asked to assess the general business situation in three regions – Germany, Europe and worldwide – the respondents came to highly positive conclusions. For example, 84% of respondents see the current worldwide business situation as positive. Beyond 29% said they were expecting their situations to improve in Europe, whereas in the current survey this value has now risen to 40%. By contrast, the proportion of those expecting a negative development has stagnated at 5%.

As a conclusion the survey shows that the respondents see their prospects as very positive for the coming months. The market is therefore likely to continue in its dynamic development – all the more so as half of all respondents believe that their businesses will become more active on the market, while only 2% are anticipating a decline.

CFRP VEHICLE

EPSILON – SMALL ELECTRIC VEHICLE CONCEPT

The project epsilon aims to conceptualise and prototype the electric urban small vehicle of 2020-2025 and defining a new vehicle class.

Within the epsilon project an innovative electric vehicle concept specifically designed for the typical commuting and transport tasks in urban areas has been developed. The epsilon vehicle provides NCAP safety level with a structural weight of only 600 kg, while providing space and comfort for three passengers. Chassis and drivetrain offer exciting driving performance (0-100 km/h in under 10 s) and 150 km range with an energy demand of just 80 Wh/km. Thus epsilon closes the gap between ultra light vehicles (L7e) and conventional passenger cars (M1) and offers efficient and at the same time save mobility.

Prototype at IKA, RWTH Aachen University

To achieve the ambitious energy efficiency and safety goals, special focus has been set on the design of the vehicle body structure. The epsilon concept incorporates a **novel CFRP-aluminium space-frame architecture**. Using the technology Axontex by project partner Axon continuous multi-chamber CFRP beams can be manufactured by braiding carbon fibre preforms over foamed polymer cores which are thus stacked and overbraided, filled with resin and cured in an autoclave. The resulting profiles are applied in the space-frame body in white (BIW) architecture to form a cell enclosing the passenger compartment. This construction is combined with modules made out of aluminium extrusion tubes as crash absorbing structures for front, rear and side impacts. This space-frame is supported by a number of sheet panels, closing the frame to a robust structure, suitable to withstand the requirements concerning stiffness and crash safety. Furthermore, GFRP exterior panels have been designed, reflecting the proposed styling but not adding to the structural performance of the body structure. In terms of lightweight design also a steel CFRP hybrid rear axle concept has been developed making use of braided pre-forms and a novel positive fit joining concept. The epsilon concept's performance with regard to the project objectives concerning safety, energy efficiency and driving dynamics has been proven on prototypes, including sub-systems, a fully body crash structure and a running vehicle prototype.

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MARCH 14 At JEC World 2017 : Hall 6 | Booth C79

HUNTSMAN POLYURETHANES

Huntsman's VITROX® resins used in complex hollow part for KTM motorcycle

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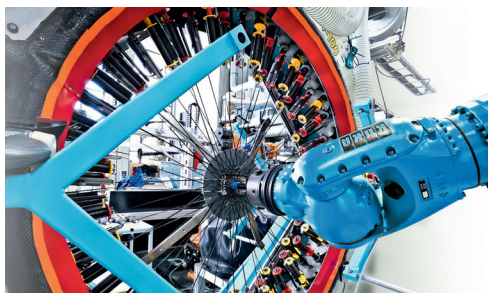
Huntsman Polyurethanes' VITROX® resin technology has been used to create an ultra lightweight license plate holder for the KTM 1290 Super Duke R motorcycle – a high performance bike with a powerful 1300 cc / 170 HP V-engine.
The innovative license plate holder was created as part of Project R.A.C.E, an industry initiative led by KTM Technologies, an engineering company with extensive know-how about the use of composite and hybrid materials and their application across a wide range of industries. KTM Technologies cooperated for the project with The Hennecke Group, which designs, produces and installs custom polyurethane mixing machines and innovative systems and technologies.
Project R.A.C.E is exploring the industrialization of the award-winning CAVUS technology – an end-to-end manufacturing methodology for producing complex, hollow, fiber-composite structural parts using automated high-pressure resin transfer molding (HP- RTM). KTM Technologies' CAVUS technology brings together a range of best-in-class technologies and materials including Huntsman's VITROX® resins. To demonstrate the potential of the CAVUS technology to create lightweight, mechanically strong parts that are suitable for high volume production, KTM Technologies and The Hennecke Group are working with a selected group of industry partners to produce a range of products. One of the team's first challenges was to create a license plate holder for KTM's Super Duke motorcycle, which is renowned for its acceleration and therefore requires ultra-lightweight, high performance components.
The existing series KTM solution for the license plate holder weighs more than 765 grams. However, using CAVUS technology, KTM Technologies and its Project R.A.C.E partners produced a high performance and high integrative part weighing only 265 grams – a saving of more than 60%.

Huntsman's VITROX® resin technology has proved central to Project R.A.C.E and the development of KTM's new license plate holder. Suitable for HP-RTM processing , this innovative polyurethane-based matrix material has unique snap cure capabilities – meaning manufacturers can carefully control the resin curing process and achieve a full cure within minutes.
Hubert Reitberger, Product Manager for Advanced Composite Resins at Huntsman, said: "Project R.A.C.E is an excellent platform where high-speed polyurethane matrix materials such as VITROX® resins can demonstrate their full performance. Self-releasing systems with outstanding mechanical properties, combined with optimized curing times, are the key to mass-producing products with a short cycle time. Project R.A.C.E and the application of KTM Technologies' CAVUS technology is a prime example of how highly specialized partners can come together to create a step change in the production of fiber composite hollow parts."
Alongside KTM Technologies, The Hennecke Group and Huntsman, other companies involved in Project R.A.C.E include H2K Minerals (now REINSICHT); the Institute of Aircraft Design Stuttgart; ENGEL Austria; Persico; and Murtfeldt Plastics.



Ultra lightweight license plate holder for KTM motorcycle

AZL WORKGROUP: HIGH-SPEED RTM MATRICES

RTM is the current state of the art technology in high-volume production of thermoset composite parts. After three workshops on "High-Speed RTM Matrices", AZL partners founded a workgroup which meets every six months. The aim of the workgroup is to enhance the trust in the RTM technology and the composite industrialization in general. Currently, a consistent Model Data Sheet for RTM resins is developed. Furthermore, the needs for e.g. near process test methods, quality assurance possibilities, automated preforming or for a material, machinery and process database will be identified for next projects.

high speed rtm
Business Platforms by AZL
>> high-speed-rtm.com

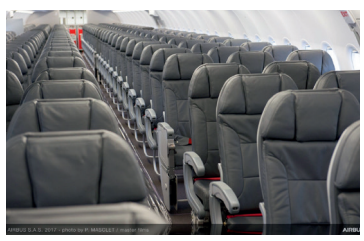
SEPTEMBER 26 Next Workgroup Meeting: September 26th, 2017

NEW SMC PRODUCTS FOR AIRCRAFT INDUSTRIES

With FAR 25 approval: SMC can be co-molded with UD or fabrics in order to give more stiffness to the final component.

NICOLE STOESS | POLYNT | NICOLE.STOESS@POLYNT.COM

The aviation industry is one of the branches with the highest growth during the last years. Lightweight design and the use of lightweight materials such as carbon fiber reinforced plastics are important key aspects for meeting the rising need for fuel-efficient civil aircraft in the future. For the cost-efficient and lead-time-related production of aircraft structures or components the development of innovative manufacturing technologies is necessary. In this context the combination of pre-impregnated continuous fiber reinforcements and sheet molding compounds reinforced by long fibers in a one-shot compression process is really promising. By using this hybrid material and this process technology functional and lightweight composite components can be realized in a cost-saving way and with short lead times. The direct implementation of metal components such as inserts, sleeves and plates promises further functional integration. Polynt Composites has invested many efforts in research and development for new class of thermoset reinforced materials to react to the increasing aircraft market requests. In particular it has been launched a new range of SMC for aircraft industries in its German plant in Miehlen (near Frankfurt) such as: HUP 27: The SMC described by HUP 27 is developed for the fire containment requirements for cargo areas and fulfills the FAR requirements according FAR 25 App. F, Part I + V and the AITM 3.005. And HUP 63: The SMC described by HUP 63 is developed for the fire containment requirements for cabin and interiors and fulfills the FAR requirements according FAR 25 App. F, Part I + V and the AITM 3.005.
Both SMC can be co-molded with carbon fiber reinforcement (fabrics or unidirectional) impregnated with the same thermosetting resins in order to give the same continuity on the organic phase.



SMC for Airbus © AIRBUS S.A.S. 2017

AZL WORKGROUP: HIGH-PERFORMANCE SMC

high performance smc
Business Platforms by AZL
coming soon:
>> high-performance-smc.com

The drive to further weight savings and significant reduction in CO2 emissions require a next generation of High-Performance SMC (Sheet Molding Compound) with short and continuous fiber reinforced systems using both carbon and glass fibers with customized resin compounds. Class-A body panels and semi-structural parts for automotive and various industrial applications are the key target for HP-SMC. The workgroup defined a joint road map to build a product development toolbox including material characterization methods, standards and norms and design guidelines. The Business Platform will be launched soon.

MAY 31 Next Workgroup Meeting: May 31st, 2017

AZL CONFERENCE AT JEC WORLD 2017: PRODUCTION TECHNOLOGY FOR MULTI-MATERIAL LIGHTWEIGHT COMPONENTS

CONTINUOUS PRODUCTION PROCESSES OF TOMORROW

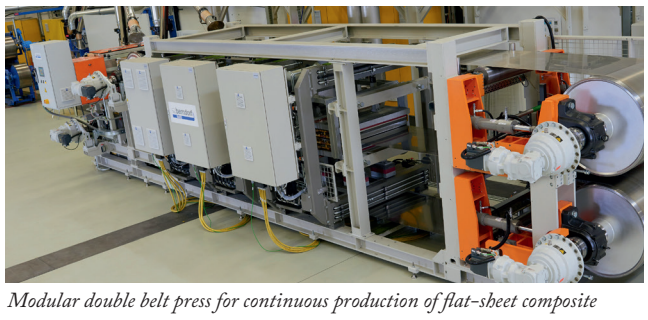
Berndorf Band Group: Highly precise steel belt systems from Austria

PETER RIEDL | BERNDORF BAND | PRI@BERNDORF.CO.AT

All over the world, the high quality steel belts and process systems of Berndorf Band Group are considered to be a technological standard. The latest development is a modular double belt press which allows for a continuous and particularly efficient production of most different flat-sheet products in the composite area. Within the scope of feasibility tests, customers can directly convince themselves of the advantages of this press type in the Research & Development Center in Berndorf.

Steel belt systems: A versatile production technology– No matter if laminate manufacturers, testing centers of the automotive industry or producers of chemical products – they all rely on individual steel belt solutions of Berndorf Band Group. "We support everything from the identification of suitable process parameters to the implementation of customized systems and their maintenance. Extensive service as well as research and development are an important part of our customer-oriented corporate philosophy", explains Gernot Binder, president of Berndorf Band Engineering GmbH. On the basis of this philosophy, a new system has now been developed, especially for the plastics industry. It allows for an even more efficient production of flat-sheet products such as thermoplastic composite materials.

More output with high flexibility: Continuous instead of static pressing – In many cases, static processes with cycle presses are used



Modular double belt press for continuous production of flat-sheet composite products

in the production of composite products. Double belt presses, on the other hand, allow for a continuous production process multiplying the production capacity and at the same time reducing the energy demand. In this connection, continuously supplied material is pressed between two endless steel belts running over four drums under targeted temperature influence. The material can be supplied in many different forms, e.g. as powder, granulate, rolled stock, mat, cast solution or tough mass.

The modularity of the system allows for the combination of any number of modules and components. On the one hand, different work steps can be carried out on one single production line thanks to this flexibility. On the other hand, the system can be adjusted to requirements of different products thanks to the fast and easy exchange of the modules without belt removal. In this connection, you can combine calender, roller, roller carpet and sliding modules which can reach process temperatures of up to 400 degrees Celsius. Roller carpet modules generate pressures of up to 2 MPa and sliding modules of up to 0.2 MPa. Roller modules generate a line pressure of up to 15 kN/m and calendar modules of up to 60 kN/m. Due to the hydraulic generation of the compressive forces in the modules, the press can be operated in an isobaric and isochoric manner.

In order to be able to adjust presses even better to the needs of thermoplastic composite materials, Berndorf Band Group strives for an intensive exchange with material manufacturers and producers.

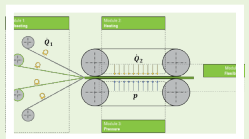
Test procedure in Berndorf: New steel belt press and competent consultation – In the Research & Development Center in Berndorf, Austria, customers can already convince themselves of the modular double belt press during the material and product development. Due to the flexible arrangement of the modules, individual production processes can be realized and checked for their effectiveness. In the area of thermoplastic composite materials, some flat-sheet products could already be produced in continuous form, e.g. CFRP (with PEEK, PA6, PP and PE), GFRP (with PA6, PP & PE) as well as organic sheets.

MARCH 15

At JEC World 2017: Hall 5a | Booth Q70
Lecture on March 15th, 10am

AZL JOINT PARTNER PROJECT: DOUBLE BELT PRESSES

The project aims at improving the energy efficiency and product geometry flexibility in production of composite sheets with double-belt presses. In the first phase of the project, the AZL, together with seven partner companies, developed a prototype for proof-of-principle of a novel cost and energy-efficient double-belt press system for the continuous production of composite sheets. The follow-up project just started to progress on the developed double-belt press system with the aim to build an industry-scaled machine according to the pursued concepts. Your AZL Contact for further assistance: Albert Wendt, albert.wendt@azl.rwth-aachen.de.



AZL JOINT PARTNER PROJECT
ULTRA-FAST MANUFACTURING OF TAILORED COMPOSITE BLANKS

To increase resource-efficiency in the production of continuous fiber reinforced plastics, the manufacturing of scrap-optimized blanks with defined fiber alignment ("tailored composite blanks") on basis of unidirectional semi-finished products (thermoplastic tapes, tow-pregs or dry-fibres) offers high potential compared to textile-based pre-products. Nonetheless, today's production systems for the manufacturing of tailored composite blanks are limited in throughput per system. The project was initialized at the Annual Partner Meeting 2015 and aims to realize a novel machine solution for the high-volume production of tailored composite blanks. Your AZL Contact: Thomas Weiler, thomas.weiler@azl.rwth-aachen.de.

MAJOR EQUIPMENT EXPANSION AT VAN WEES UD AND CROSSPLY TECHNOLOGY

The successful pilot productions at Van Wees have led to the sales of the first thermoplastic UD tape production machine and the decision to close the chain for composite tailored blanks production with a new machine and equipmentand machining of high-strength steels for lightweight applications mainly for the automotive industry are running. Shear cutting of composite structures on a press is scheduled.

From 2014 onwards, Van Wees has noticed a continuous growing demand for the production of thermoplastic resin based UD tapes. In its Research and Technology Center (R&TC) the UD tapes can be made on three different machines. The width is 600 mm maximum and these rolls can be slit in-house to smaller width. The UD600 TPR is used on daily basis and several tons of UD tapes are

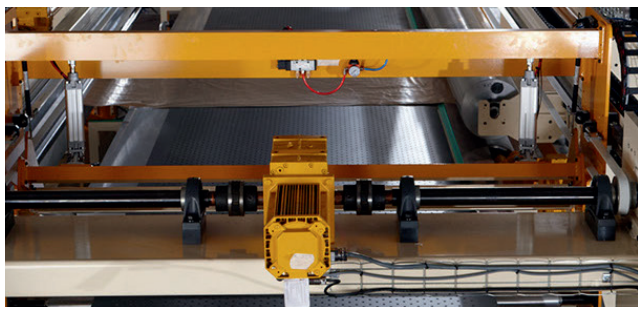


Fig. 1: Multi-axial UD1800 machine

Fig 2.: Double belt calander in operation

already made for interested parties. These tapes are used for evaluation of the customers resins and fibers. By running the machine for longer periods, the customer can experience the equipment capabilities, develop its products and the operators will be trained for a smooth startup when the machine is installed.

The Van Wees R&TC machine is recently equipped with a double belt calander with steel cooling belts. This addition has increased the tape quality due to better control of the process variables. It also opens new possibilities for making thicker tapes, multi-materials and other lamination processes.

The R&TC will be expanded with a new UD placement machine. For making tailored blanks, a multi-angle ply cutting machine and welding equipment are present. The plies from this machine are manual welded according to the ply book configuration. The panels can be made with these laminates on a press of 800 x 500 mm.

Van Wees has built two Crossply machines, one in 2012 and one in 2014 for its R&TC. The first one was a large Multi-axial UD machine, working width 1.800 mm and the later version was a robot based unit. Both machines were not according to the performance and operational wishes and therefore a new design is made. Using the experience from the "old" versions, a new generation machine is configured in which all knowhow is bundled. This high automation machine will be operational after the summer of 2017.

Van Wees always welcomes ideas for testing on its equipment and recently performed new trials with flax fiber based UD tapes. Having worked 2 – 3 years on this product from 2010 onwards, but without success in the market, it is good to notice that also this material is gaining interest again.

Rien Van Den Aker
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STATEMENT

PETER EGGER: "IN-SITU POLYMERISATION ON THE ROAD TO SERIES PRODUCTION"

In order to close the gap to an efficient production of fabric or fibre-reinforced light-weight components, Engel realised an integrated and highly automated process for the in-situ polymerisation of Caprolactam to form fibre composite carrier structures which are functionalised through injection moulding. The multi-component process uses fibre fabric, ε-Caprolactam and thermoplastic granules to create lightweight, ready-to-fit parts. Peter Egger, Director of the ENGEL Center for Lightweight Compo-site Technologies explains the advantages of in-situ polymerisation.

"In-situ polymerisation offers major opportunities for us when it comes to producing complex composite parts as efficiently and cost-effectively as possible. Generally speaking, various procedures are available. The multi-stage approach, employing pre-consolidated semi-finished products which are trimmed, heated, shaped and overmoulded is useful where waste can be kept to a minimum and no local reinforcements are needed to improve stiffness and strength. Reactive processes, which include HP-RTM and in-situ polymerisation, offer ad-vantages in connection with complex lay-up conditions, hollow profiles and hybrid layer struc-tures. However, additional functionalisation as regards the HP-RTM process is relatively complex. The resulting components are based on epoxy resin or polyurethane so that typical-ly, joining elements and reinforcing structures need to be manufactured separately and fixed to the structural component. On the other hand, in-situ polymerisation produces polyamide 6, onto which functional elements can be moulded directly. In-situ technology therefore enables us to improve production efficiency while following the trend towards an increased use of thermoplastic matrix materials."

» *In-situ polymerisation offers major opportunities.*

Peter Egger
Director Center for Lightweight Composite Technologies | ENGEL AUSTRIA GmbH
Peter.Egger@engel.at

DEVELOPMENT OF A FULLY AUTOMATED ADHESIVE BONDING PROCESS

Consideration of large-scale manufacturing conditions – with the use of Laser irradiation as pre-treatment method for FRP

The increasing application of material mixture results in a growing importance of the adhesive bonding technology as the most promising joining technique for multi-material joints. Until now, the use of adhesive bonding for multi-material joints is, however, connected with high process-technical expenditure. Despite the successful implementation in individual applications, the methods have not yet been sufficiently developed for large-scale manufacturing. One of the most important challenges is the provision of robust surface pre-treatment methods in order to ensure efficient and durable adhesively bonded joints. Furthermore, methods have to be developed which make it possible to achieve the handling stability of the joined components within a very short time. The development and integration of this methods into the adhesive bonding process remains challenging under the boundary conditions of large-scale manufacturing.

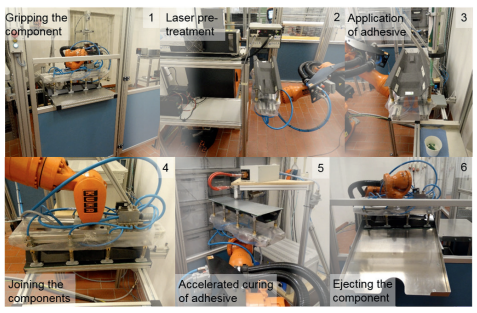

Fig. 1: Laboratory size adhesive bonding process chain

At the Welding and Joining Institute (ISF) at RWTH Aachen University, a process chain in laboratory size was developed and built (see figure 1). In this process chain components of FRP and metal are adhesively bonded fully automatically. The process chain includes a 6-axis industrial robot, a vacuum gripper system, a CO2-CW laser system for the pre-treatment of (fiber-reinforced) plastics, an adhesive dosing unit for processing 1K or 2K adhesive cartridges, a joining device and an induction system for accelerated curing of the adhesive joint. Alternatively, an atmospheric pressure plasma system can be used for pre-treatment instead of the laser system.

With this existing opportunity, bonding and related joining processes between various materials can be tested for feasibility studies. Additionally, it is possible to gain detailed information about the process in terms of e.g. process time, reproducibility, practicality and economicality. Feel free to contact us, if you are interested in the development of modern adhesive bonding process chains, related processes as thermal direct joining, hybrid joints of FRP and pin structurised metals, repair concepts for FRP or smart structural heath monitoring (SHM) systems (see figure 2).

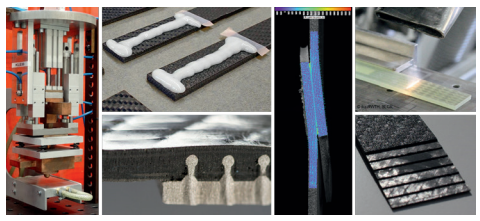

Fig. 2: Adhesive bonding and related processes at ISF

Bernd Marx
Team leader Adhesive Bonding Technology | Welding and Joining Institute (ISF) at RWTH Aachen University |
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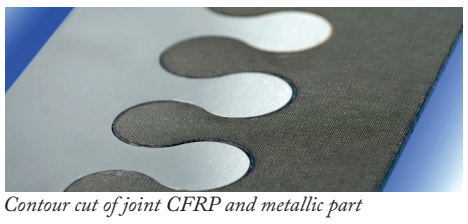
NOVEL LASER-BASED PROCESSES FOR JOINING AND CUTTING OF HYBRID COMPOSITE-METAL-COMPONENTS

Aiming at more efficient and flexible processing of lightweight components, Fraunhofer ILT has developed new joining and cutting processes for multi-material designs.

KIRA VAN DER STRAETEN AND FRANK SCHNEIDER | FRAUNHOFER INSTITUTE FOR LASER TECHNOLOGY ILT
KIRA.VAN.DER.STRAETEN@ILT.FRAUNHOFER.DE | FRANK.SCHNEIDER@ILT.FRAUNHOFER.DE

Background – A key requirement in the automotive and aerospace industries is to reduce weight through innovative lightweight construction concepts. To achieve this ambitious goal, a material mix combining fibre reinforced composites and lightweight metals like high strength steel, aluminum or titanium is a promising approach. The use of different materials in multi-material construction, each adapted to local loads, has opened up avenues for weight optimization. While plastics are characterized by their low weight, low price and almost unlimited shape, metals can withstand significantly higher loads due to their mechanical properties. However, processing of plastic-metal hybrids like joining and cutting poses a particular challenge.

Hybrid injection molding of laser microstructured metal components – Over the past years Fraunhofer ILT has developed a process chain to connect plastic with metal, in which microstructures are generated in the metallic bonding partner by means of laser radiation. In collaboration with BARLOG GRUPPE the modified metallic parts were integrated into an injection molding process in order to fill the cavities directly with molten plastic. After the plastic solidifies, a solid and permanent bond is created based on mechanical interlocking. To evaluate the connection different structure patterns and process parameters with various plastic materials were tested. This process chain has produced durable and solid connections with a tensile shear strength of more than 22 MPa. The strength of the joint is not only significantly influenced by the structural density and orientation on the metal part and the plastic material properties, but also by the process control and the metal components temperature during injection molding.



Contour cut of joint CFRP and metallic part

Laser cutting for joining preparation – Some joining techniques as riveting or form locking joints need a precise contour or edge preparation of the joining partners. For the preparatory cut of metal and composite parts the laser can be used, offering the versatility to provide adapted processes for the very differing material properties. Applications can be cutting of holes in already stacked components of titanium or aluminum and CFRP for riveting or contour cutting for combined form locking and adhesive joints.

The cutting method for CFRP is an ablation process, removing material to the top side in several scans digging a kerf into the material by the focused laser beam. In case of stacked material, a scan strategy is chosen that generates a kerf down to the metal part with a contour optimized for the following process step, the metal cutting. For this a gas assisted single path process is employed with adapted processing parameters. A smooth link between the components is reached for stacked material as well as for material side by side in butt joints with an interlocked contour. This novel cutting process combination was demonstrated with the same beam source both for CFRP and metal, but for technical or economic reasons a solution with different lasers might also be attractive depending on the application.

AZL WORKGROUP: HYBRID THERMOPLASTIC COMPOSITES

thermoplastic composites
Business Platforms by AZL
>> tp-composites.com

Production processes combining continuous and short or long fiber reinforcements allow a high design flexibility as well as good mechanical properties at the same time. Thus, overmolding of FRP inlays is a popular process to functionalize thermoplastic semi-finished products and local reinforcement by AFP increases significantly the performance of plastic components. Within the AZL workgroup "Hybrid Thermoplastic Composites" faces technological challenges such as thermal management, thermoforming, handling and fixation, trust in technology and cost-efficient design.

OCTOBER 10

Next Workgroup Meeting: October 10th, 2017

PRODUCT-ORIENTED AUTOMATION CONCEPTS

For Fiber-Reinforced Plastics Produced Using FiberForm Technology

DR. MESUT CETIN AND STEFAN FENSKE | KRAUSSMAFFEI | MESUT.CETIN@KRAUSSMAFFEI.COM | STEFAN.FENSKE@KRAUSSMAFFEI.COM

State of the art – Lightweight structures are used not only for weight reduction and, thus, for the implementation of legal requirements such as lower CO2 emissions in the automotive sector, but also for the integration of functional elements. In view of the above-mentioned requirements, injection molding of thermoplastics is highly suitable. Injection molding allows a high level of design freedom, short cycle times and the implementation of continuous fiber structures. The FiberForm process developed by KraussMaffei (Figure 1) combines thermoforming of organic sheets and injection molding in one process. The results are weight-reduced, fiber-reinforced plastic components with high strength.

		Heating concept	Automation	Semi-finished product size (b x h)	Exemplary applications
Concept	1	Infrared technology	Linear unit with two kinematics (LRX 250 TwinZ)	≤ 350 mm x 350 mm	Airbag housing, small holder,
	2		Linear unit with two kinematics (LRX 500 TwinZ)	≤ 850 mm x 850 mm	Battery carrier, seat shell, cross-beam
	3		Two articulated robots	≤ 1350 mm x 850 mm	Door panel, bumper bracket, assembly carrier

Table 1: Automation concepts for the production of fiber-reinforced thermoplastic components using FiberForm technology

Challenges – Economical use of FiberForm technology largely depends on the automation concept, the heating concept and the size of the injection unit (Figure 2). Due to different process-varying components, the effect which the individual cost factors have on component prices changes.

Manufacturing Concepts – Based on the challenges, KraussMaffei has developed three concepts for three different organic sheet sizes (Figure 2). The concepts are developed based on low cycle times, minimal installation space, flexibility and low component costs.

Characteristic of all FiberForm concepts is the positioning of an infrared heating station above the fixed clamping plate. Thanks to this heating concept, very short transfer moves are possible to insert the heated organic sheet into the molding tool. This results in very short transfer times of the organic sheet into the tool and therefore facilitates high series production of components. The infrared technology is used as a heating principle. Depending on the thickness of the semi-finished product, heating takes place on one side or both sides. The dimensions of the infrared heating area depend on the size of the organo sheet and the corresponding injection molding machine, but can also be customized. Two decoupled robot units are defined as automation kinematics. As a result, heating of the organic sheet and removal of the finished part can be decoupled from one another in terms of time, which leads to a further reduction in the cycle times. Due to the different component sizes, the robot kinematics differ in terms of their freedom of movement and their load capacities.

KraussMaffei's product-oriented automation concepts ensure series production of long fiber-reinforced thermoplastic components in very short cycle times for large quantities. The reasons for this are as follows: selection of infrared technology as a heating principle, positioning of the infrared heating station above the injection molding machine and optimized selection of the automation kinematics for different component sizes. All presented concepts have already been implemented for customers in series production by KraussMaffei.

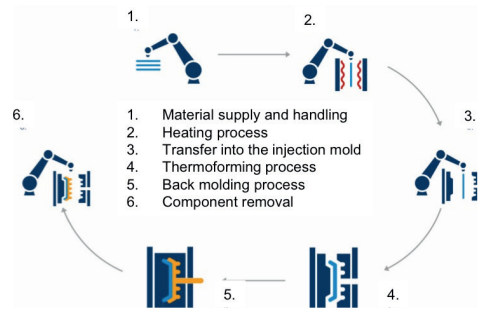


Fig. 1: Process sequence for KraussMaffei FiberForm technology

K 2016 PRODUCTION CELL NOW AT IKV

With new tape plant

FELIX HASCHKE AND CHRISITAN BESTE | IKV AT RWTH AACHEN UNIVERSITY
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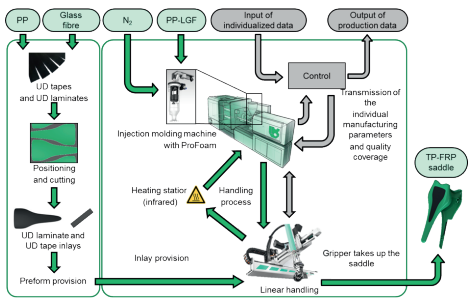
Due to the increasing individualization in production, variant production gets increasingly important. Hence, the Institute for Plastics Processing at the RWTH Aachen (IKV) presented a production cell for the production of individualised composite parts at the K2016 show together with an industrial consortium (Fig. 1).



Sequence of individualised injection moulding (© IKV)

Using the example of a bicycle saddle, six different variants could be produced fully automatic according to customer preferences. The different component variants were produced by means of the optional integration of a local reinforcing insert, the variation of the structural thickness by means of the thermoplastic foam injection molding and the injection volume. Due to an overlapping network of the system components via a master computer, individual access orders via an internet-capable terminal could be issued individually with corresponding access data. The master computer takes over the coordination of the process by passing the parameters of the next cycle to the injection molding machine according to the production list.

The production cell was made available to the IKV after the K2016. Thus, the IKV is able to use the plant for further research purposes, e.g. investigations on the variety-rich production. The research activities for the local, unidirectional reinforcement of injection molded parts are complemented by the production of unidirectional (UD) tapes using carbon or glass fibres with a thermoplastic matrix as well as the subsequent forming.

IKV has a new extrusion-based production facility for the production of UD tapes with an online quality assurance system. The plant technology was developed with the partners Breyer GmbH Maschinenfabrik, Pixargus GmbH, F.A. Kümpers GmbH & Co. KG and KUKA Industries GmbH in the publicly funded BMBF project LightFlex. Current research activities in this area focus on the interactions between measurable quality data and the profitability of the process. The built-up tape line allows for the production of UD tapes with a tape width of 25 to 75 mm, a tap thickness of 0.1 to 0.3 mm, at a production speed of 0.6-10 m / min. The processing of glass fibres (> 2,400 tex) and carbon fibers (> 24K) as well as polypropylene or polyamide matrix is possible. This allows for a production of UD tapes with specific properties. Together with the forming of thermoplastic composites in the Double-Diaphragm-Forming process or the back-moulding of such structures, a continuous process analysis can be done at IKV.

AZL JOINT PARTNER PROJECT

CORRELATION OF MORPHOLOGY AND MECHANICAL PROPERTIES OF TP-FRP LAMINATES

The project is devoted to reveal the influence of morphological imperfections on mechanical behavior of thermoplastic unidirectional fibre reinforced plastics (TP-FRP). Within the project AZL will systematically vary the morphology of UD-FRTP laminates, determine the resulting mechanical performance and expose underlying mechanisms. Based on the input of several AZL partners, the project content was recently defined. Offers will be sent out shortly. Correlation of Morphology and Mechanical Properties of TP-FRP Laminates is the follow up activity of our first one-year Joint Partner Project in which different commercially available tapes were benchmarked and interactions between tape, process and resulting laminate properties were investigated.

>> Project is still open to join for AZL Partner Companies, please contact Sebastian Stender, sebastian.stender@azl.rwth-aachen.de

CONFERENCES OF AZL INSTITUTES

MARCH 15
Production Technology for Multi-Material Lightweight Components

MARCH 17
Symposium for Tailored Carbon Fiber and Composites 2017

APRIL 17
4th UKP Workshop

MAY 4
Seminar Efficient Processing of High-Strength Steels

MAY 15 - 17
Seminar Process Chains of Fiber-Reinforced Plastic Parts

SEPTEMBER 19-20
Aachen Body Engineering Days 2017

Find more on Conferences and Seminars at the AZL Partner Section

INTERNATIONAL COOPERATION ON INNOVATIVE WINDING TECHNIQUE

The installation of the innovative and economic production technology "MFW-48" is making progress in January 2017

PIA MÜNCH | PIA.MUENCH@ITA.RWTH-AACHEN.DE

Murata Machinery Ltd., Japan, producer of advanced and innovative textile technology, is introducing the new Multi Filament Winding (MFW) technology MFW-48 to the market. To establish MFW as innovative and economic production technology for composite structures in the German and European market, Murata and Institut für Textiltechnik der RWTH Aachen (ITA), one of the biggest textile institutes in Germany, started collaboration. The installation work of the machine MFW-48 at ITA commenced in January 2017.

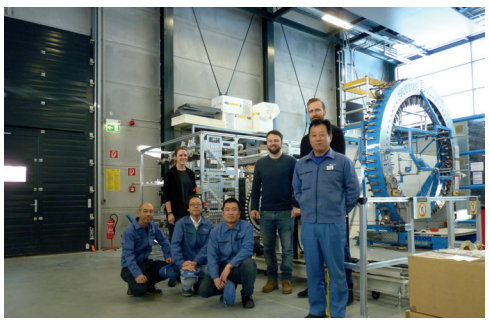


Fig. 1: Engineers from Murata and ITA successfully commissioned MFW-48 ©ITA

The new technology MFW-48 has the capability to process 48 fibres simultaneously. It offers the potential to produce structures for composite applications with outstanding mechanical properties in a highly productive way. A mandrel rotates and moves back and forth horizontally, while the reinforcing fibres, e.g. carbon, are positioned on the mandrel successively. These tubular parts are characterised by a unidirectional and non-crimped structure to increase mechanical properties in fibre direction. During the rotation, a complete layer is placed down on the mandrel at the same time. The outcome of this is that the machinery allows short manufacturing times, high economic efficiency and increases productivity of preforming process. With these characteristics, MFW-48 meets the requirements for series production.

The next step will be the evaluation of technical characteristics of the MFW process and composites to open up new ways and opportunities for prototyping and analysis of the technology for various applications. Especially, the production of lightweight pressure vessels will be taken into consideration. In automotive industry, these vessels can be used to store hydrogen and thus make an important contribution towards implementing the turnaround in energy policy and CO2 reduction.

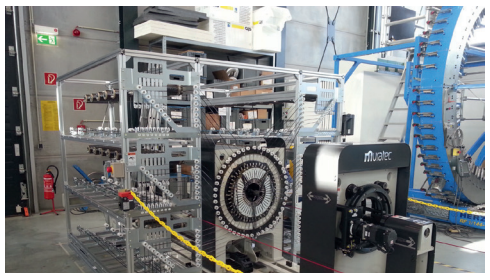


Fig. 2: Multi Filament Winding Machine MFW-48 ©ITA

ITA expresses their gratitude to the partner Murata Machinery Ltd. for the good collaboration and the intensive efforts on site at ITA in Aachen.

AZL WORKGROUP: PIPES AND VESSELS

MAY 30 — Next Workgroup Meeting: May 30th, 2017

composite pipes and vessels — Business Platforms by AZL

coming soon:
>> composite-pipes-vessels.com

Pipes and vessels represent an ideal application for fiber-based materials. Therefore, fiber-based materials are of growing interest for fluid transportation and storage in industries like oil, water or gas, but also for the transportation sector. Lightweight for low handling and transportation cost, non-corrosiveness for long service life are some drivers behind that interest. The AZL Partners defined "Pipes and Vessels" to be a topic for a new workgroup meeting every six months. So far, two workgroup meetings took place working on an Aachen Institutes Competence Matrix regarding pipes and vessels, the development of a generic pressure vessel and of a Business Platform "Composite Pipes and Vessels" which will be launched soon.

MACHINING OF HIGH STRENGTH STEELS AND SHEAR CUTTING OF COMPOSITES

The Fraunhofer IPT extended its machinery with a 200 ton servopress in 2016

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Research projects for local heating and machining of high-strength steels for lightweight applications mainly for the automotive industry are running. Shear cutting of composite structures on a press is scheduled. The use of high-strength steels is known as a key factor to enable cost-efficient lightweight design. With its improved properties, these steels guarantee customized functionality and simultaneously a reduction of mass. As a matter of fact, the advantages in the application turn into difficulties during the machining process. The high strength causes quick wear of the tools. Often poor cut surface qualities occur in shear cutting processes.

Local heating of the high-strength sheet metal with laser

These difficulties can effectively be overcome by using local heating of the high-strength sheet metal. With several years of research in local laser heating of high-strength steels, Fraunhofer IPT built up experiences and competencies in developing corresponding systems and processes for the integration of this novel approach in existing sheet metal working processes. The local laser heating softens the material temporarily and enables production processes like shear cutting and bending with clear cut surfaces of up to 100% and high degrees of deformation.

Schuler servopress (maximum force of 2000 kN) at Fraunhofer IPT

Based on the experiences with laser radiation for the heating of complex geometries, different techniques like inductive or conductive heating are currently developed at the IPT. Depending on the process parameters also local hardening is possible and load optimized properties of individual parts can be achieved in order to further reduce component weight.

With the commissioning of a Schuler servopress with a maximum force of 2000 kN in 2016, Fraunhofer IPT has the opportunity to operate under industrial conditions. As an application oriented research organization, Fraunhofer IPT offers research activities and the development of integrated heating systems and processes under an industrial point of view.

In order to exploit further lightweight potential, the IPT is going to extend the bandwidth of analyzed materials on the servopress. Examples are Aluminum as well as composite structures and sandwich materials. The use of the press as a test bench for shear cutting of composite materials is possible. That includes the cutting of outer contour as well as shear cutting within the part.

Also in the upcoming years, Fraunhofer IPT is your partner for any material- and process-based research in the field of lightweight design. At a seminar on the 4th of May, 2017, a detailed overview about industrial machining of high-strength steels and research activities in this field is going to be presented at the Fraunhofer IPT in Aachen.

MAY 04 Seminar see Page 9

LASER-ASSISTED WINDING

HIGH SPEED WINDING OF THERMOPLASTIC HIGH PRESSURE VESSELS

ARNE BÜTTNER | AFPT
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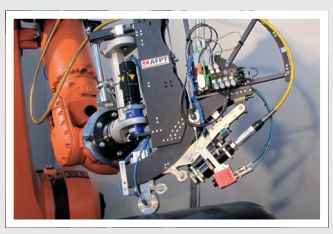
AFPT developed a high speed winding head for large scale composite vessel manufacturing.

The growing demand on the low carbon dioxide emitting vehicles within the automotive and transportation sector, promotes and encourages the usage of fuels like CNG or hydrogen. The composite vessel technology allows tank systems with high working pressures combined with low structural weight. The well known technology was hindered so far by the high material and production costs. AFPT faced the challenge to develop an innovative production technology that meets the requirements of an industrial scale vessel manufacturing. The technology is based on a thermoplastic prepreg material, which is heated by laser energy and consolidated by a compression roller. The so called in-situ consolidation allows the curing of the laminate during the winding process. So no post-processing in an autoclave or hot press is necessary. The laser is a very energy efficient heat source that can be well controlled, especially at high winding speeds. The process also contains less health risks, because it avoids open resin systems and the process happens fully automated in a safety enclosure.

The new winding head was consequently designed to face the requirements of the high speed vessel winding. Most important goals have been the reliability and the productivity of the system. By optimizing the head and its handling system the maximum winding speed has been increased from 20 m/min up to 90 m/min. To withstand these velocities the tape guiding system has been completely redesigned. Also the tape tension system has been adapted to higher tape tensions, which also increases the consolidation and laminate quality.



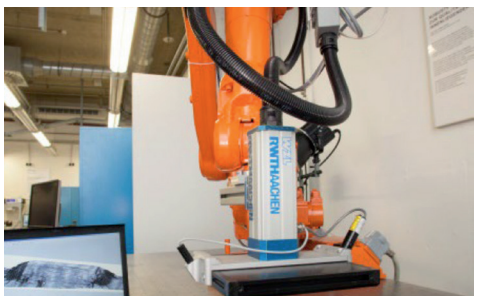
AFPT winding head for vessel manufacturing

QUALITY ASSURANCE FOR COMPOSITES

The quality assurance during composite life cycle is essential for a successful and economic application. The WZL offers the Fiber Measurement Sensor (FMS), designed for inline applications and also develops individual software solutions for automated defect detection.

The industrialization of the production of composites is still impede by insufficient quality assurance methods. To increase the production speed and decrease scrap quota automation and an automatic adaption of the behavior of the quality assurance system to dynamic production conditions is essential.

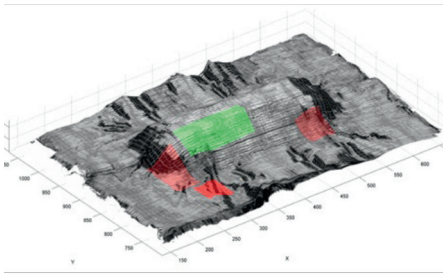
Therefore, at the Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University, a new method was developed, which enables the measurement of the geometry (macro form) and the local fiber orientation (micro form) by data fusion algorithms. Defects in the textile structure and preforms are now fully automated detectable and classifiable. The system is available as a robot-based or as a multi camera set-up.



Fiber Measurement Sensor (FMS) for inline applications

For the inspection of composites parts in field use thermography and ultrasonic systems are common sensor systems. The optical lock-in thermography is an active heat flow analysis, which is well suited for the inspection of carbon fiber reinforced plastics (CFRP). Large areas are covered in a single inspection step with contact-free infrared excitation and high-resolution infrared sensors. Ultrasonic testing is characterized by high flexibility and cost efficiency which are important factors for the realization of a quality assurance method for CFRP.

The Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University develops solutions for the automated defect detection of manufacturing errors or damage due use as delamination, fiber breakage and matrix cracks. In addition, (adhesive) bonding points and wall thicknesses can be investigated nondestructive.



Software solutions for automated defect detection

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MOLDEX3D R15 – GROUNDBREAKING ENHANCEMENTS TO BE EXPECTED!

CHRISTOPH HINSE | SIMPATEC | C.HINSE@SIMPATEC.COM

Aachen – A balanced conduct of cost, quality and efficiency during every stage of the process, product and tool development surely guarantees coping with the daily challenges encountered within the market. Moldex3D is dedicated to assist part designers and mold makers to develop and produce higher quality products in form, fit and function at lower costs and reduced times-to-market. The recent release of Moldex3D already surprised the users with its numerous developments but far more novelties and groundbreaking enhancements are to be expected in Moldex3D R15 all of which can dramatically improve the speed, robustness and reliability of simulation and thus allow enterprises to get the most out of virtual simulation for injection molding and create core competiveness and add a substantial amount of value to their products.

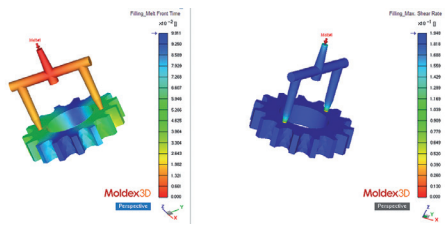

Fig. 1: With the new Moldex3D Platform – Studio Simulations and pre-post operations can now be completed in one application and multi-run comparisons are supported.

Completely New Platform - Studio – One path-breaking development to look forward to is new Moldex3D Platform – Studio. The necessity to use two applications to perform a simulation is a feature of the past. Simulations and pre-post operations can now be completed in one application. A ribbon style user interface is guaranteed and high-performance rendering promises smooth and fast operations. Another great advantage is the extremely reduced file size. Furthermore, multi-run comparisons are supported as well as hot-key operations.

Designer BLM 3.0 goes to an entire new level – The new version of Moldex3D R15 will take the Boundary Layer Mesh (BLM) generator to a completely new level. BLM 3.0 will not only allow using fewer meshing elements which dramatically reduces the meshing time whilst keeping up the maximum wall thickness resolution but will also enable extraordinary possibilities in terms of advanced meshing and flexibility. Furthermore, the capabilities and options of non-meshing technology have been extended, optimized and intensively modified. More components such as cooling channel, heating rod, mold insert, and mold base are supported. This makes the solid mold base mesh preparation job a lot easier and cuts down meshing hours significantly and temperature results show a smooth outcome. BLM 3.0 thus revolutionizes your simulation to a whole new, highest possible level of efficiency and performance.

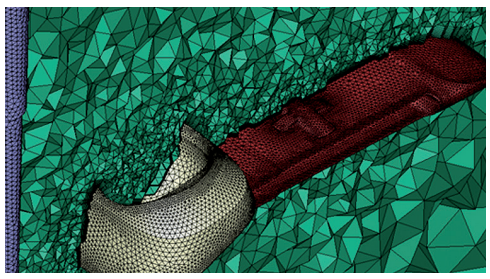

Fig. 2: The new Moldex3D Boundary Layer Mesh (BLM) generator 3.0 allows extraordinary possibilities in terms of advanced meshing and its flexibility. The non-meshing technology has been intensively modified.

INFORMATION

HEXCEL AT JEC 2017

Composite innovations for aerospace, wind energy, automotive and recreation industries

As a leading manufacturer of carbon fiber and composite materials Hexcel is promoting a number of composite innovations for aerospace, wind energy, automotive and recreation industries at JEC World 2017.

Aerospace promotions include advances in HiTape® carbon fibre reinforcements for the automated lay-up of preforms for aircraft structures that are manufactured out of autoclave by resin infusion.

Aerospace displays include an Airbus A320 neo fan cowl for the LEAP 1A engine made with Hexcel's carbon fibre, structural prepreg, dry fabric and RTM6 resin. Also a Main Landing Gear door by Daher for Gulfstream made from Hexcel's HexWeb® Engineered Core and demonstrating Hexcel's expertise in potting, splicing, forming & NC machining of honeycomb.

Hexcel's automotive technologies promotions include a suspension knuckle made by St Jean Industries in which the aluminum structure is stiffened with HexPly® M77 prepreg stacks, resulting in a 26% increase in stiffness compared to the aluminum-only knuckle, without any increase in part volume. The prepreg stacks are bonded to the aluminum with Redux® 677, Hexcel's new fast curing film adhesive for the high volume processing of metal/CFRP hybrid structures.

Hexcel will also display a composite floor demonstrator manufactured for Jaguar Land Rover using HiMax™ carbon fiber multiaxial fabrics. Hexcel created a non-crimp fabric with the optimum balance between drape, stability and permeability, using an automotive-grade standard modulus, high tow count carbon fiber.

Polyspeed® Pultruded Carbon Profiles are new technology from Hexcel for pre-cured, thick-ply carbon fiber elements, offering an economical way of structurally reinforcing wind turbine blades. Carbon fiber tows are impregnated with a thermoset resin and shaped and cured in a continuous pultrusion process, resulting in perfect fiber alignment and a smooth surface. Pultrusion is a cost-effective solution for achieving standardized geometries in high volume production. Hexcel's displays at JEC include a 2 meter diameter carbon laminate coil made from Polyspeed® carbon fiber pultrusion for the structural reinforcement of a wind turbine blade.

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IMPRINT

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9 AZL PARTNER INSTITUTES

» 750 Scientists and 1.100 Student Workers working at RWTH Aachen University on Lightweight topics

MORE THAN 80 AZL PARTNER COMPANIES

» Constantly growing Partner Network consisting of Partner Companies along the entire Value Chain from 20 countries

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AZL CONNECTING RESEARCH AND INDUSTRY FOR LIGHTWEIGHT PRODUCTION

RWTH Aachen University is one of the worldwide leading universities in the field of production technology. The Aachen Center for integrative Lightweight Production (AZL) of RWTH Aachen consolidates the lightweight expertise of eight partner institutes with 750 scientists on the RWTH Aachen Campus. The AZL builds an international partner network between these institutes and more than 80 international companies involved in lightweight production. For this, AZL consists of two separate entities: The AZL of RWTH Aachen University addresses the transformation of lightweight design in mass production with basic research and development of lightweight products, materials, production processes and systems with access to the latest full-scale machines and automation systems. As a service provider partnering with companies in the field of lightweight production technology, AZL Aachen GmbH provides industrial services in the areas of engineering, consultancy and project management, networking and business development. Together as AZL, we are the one-stop shop for lightweight production technology and offer holistic and cross-industry solutions.

With the AZL Partnership, the AZL Aachen GmbH enables the close cooperation between the lightweight industry and the research institutes of RWTH Aachen Campus along the whole value chain.

>> www.azl.rwth-aachen.de
>> www.lightweight-production.com

OFFICES FOR AZL PARTNERS IN NEW PRODUCTION ENGINEERING CLUSTER

Lightweight experts working shoulder to shoulder at the RWTH Aachen Campus

Production Engineering Cluster on RWTH Aachen Campus

With co-working spaces and exclusive offices in the new Production Engineering Cluster, AZL is bringing together its industrial and research partners within the heart of Europe's largest landscape for production technology. By working shoulder to shoulder, AZL Partner Companies keep their finger on the pulse of new technologies and are in direct contact to experienced industrial and scientific lightweight players. Besides having an inspiring presence to bring their employees and their customers, companies can connect their R&D to the high-tech environment and make us of the nearly unlimited equipment and hardware of RWTH Aachen. The packages include fully equipped co-working spaces for AZL Business Partners and one exclusive office room with complete infrastructure for two employees for each AZL Premium Partner. Meeting rooms as well as a communication zone are available. More information see www.azl-aachen-gmbh.de.

UPCOMING AZL MEETINGS

April 25

AZL OPEN DAY
Lightweight in Aachen 2017

May 30 - 31

PIPES & VESSELS | HIGH-PERFORMANCE SMC
Workgroup Meetings

June 21 - 22

AZL ANNUAL PARTNER MEETING 2017
Discuss the activities of the last 12 months and define future topics and projects with us!

September 14 - 15

B2B NETWORKING EVENT AT IAA FRANKFURT
Keynote Presentations | Networking Dinner | Guided Visits to company booths

September 26

HIGH-SPEED RTM MATRICES
Workgroup Meeting

October 10

HYBRID THERMOPLASTIC COMPOSITES
Workgroup Meeting

October 12 - 13

JOINT BUSINESS DEVELOPMENT TRIP TO POLAND
B2B Meetings at Kompozyt Expo 2017 | Guided visits to Polish Composite Companies
» See Page 5

November 15

HIGH-PERFORMANCE SMC
Workgroup Meeting

November 23

PIPES & VESSELS
Workgroup Meeting

Find more details on » azl-aachen-gmbh.de or the >> AZL Partner Section

AZL @ JEC WORLD

At JEC World 2017, the AZL Partner Institutes present their latest research at the special exhibition zone "Composites in Action". On March 15th, JEC Group and AZL organize a conference on "Production Technology for Multi-Material Lightweight Components" and guided tours to booths of AZL Partner Companies. Since 2015, AZL and JEC Group cooperate with the aim of jointly promoting developments and insights regarding integrative lightweight production technology. ATL @ JEC World 2017: **Hall 6 | C79**

jec world
International Composites Event
Paris, March 14·15·16·2017

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