CARBON COMPOSITES MAGAZIN

SPECIAL EDITION IN ENGLISH



STARBON COMPOSI



MESSE RUNDGANG EXHIBITION TOUR

"Composites Europe 2016": Trade fair with 2nd International Composites Congress (ICC) Looking back at "Experience Composites – powered by JEC Group" Annual Key Topic "Recycling"



CONTENT

Dear reader,

"Carbon Composites Magazin" is partitioned into five chapters: News and Reports from the 'CCeV-Network' is followed by contributions of CCeVmembers to an annually changing 'Key Topic'. The next three chapters correlate to the line of production: 'Layout and Characterisation', ensued by 'Production and Processing' and completed by 'Industries and Cross Section'.

The issue of the "Carbon Composites Magazin" at hand is released in due time for the Composites Europe 2016. Suitable for the international attendants of this major European Trade Fair and forum for composites, technology and application with its good reputation as international business platform for the composite industry this is going to be the first edition of the "Carbon Composites Magazin" to be published in English. Henceforward one out of four annual issues is going to be provided in English.

We do hope you enjoy reading and find professional inspiration by browsing in our magazine – made especially for you by the CCeV editorial department

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PERSONALLY

Frédérique Mutel, JEC Group President and CEO



JEC Group's target is to push the usage of composites materials and open paths. "Experience Composites powered by JEC Group" was a wonderful opportunity to do it. Germany is a fertile soil when it comes to composites developments and innova-

tions. Indeed, the close relationship of the Golden triangle made of Government, Industry and Research together with Material Sciences and Engineering is perfectly applied here. This could be witnessed during "Experience Composites powered by JEC Group" last September in Augsburg as this event brought together exhibitors and attendees covering the whole composites value chain from raw material suppliers to OEM and end users strongly enriched by the academic and scientific communities.

When the concept of this new event was defined with the envolvement of three partners such as CCev, Messe Augsburg and JEC Group, we were confident on the quality of the platform we would deliver. The first "Experience Composites powered by JEC Group" demonstrated the efficiency of cooperation between complementary partners. Together we managed to mobilize the most brilliant companies and experts in Materials and Manufacturing. We created a unique event with an original format generating new horizons. The final market especially Automotive and Aerospace could measure the advances of our industry. We combined our expertise and network to deliver a very successful Experience Composites. No other show in Germany combines the variety of services provided to exhibitors and attendees as well as high level conferences sessions and multi-located site visits and networking events. The event was exploring new fields in terms of materials, new matrices, new fibers, hybrid composites. For instance, textile reinforced concrete was one of our subjects. Carbon concrete: not common! New populations of architects or builders joined and investigated the potentialities.

We are proud to serve the German and European composites professionals with a top quality international event and are deeply motivated to prepare the second "Experience Composites" with such a qualitative approach and strong local support. The outcomes were so positive that we have already planned the next sessions being confident that Experience Composites will steadily be part of the composites panorama. JEC Group has always been a market-driven organization, adapting to the needs of the Industry in terms of knowledge sharing and networking events. Doing so has helped us become the number one composites industry organization in the world. We are an agile organization seizing opportunities and always excited to open new paths with valuable partners.

Yours,

Frédérique Mutel

JEC Group President and CEO

FIRST TIME: COMPOSITES GERMANY PAVILION

"Composites Europe 2016": Trade fair with 2nd International Composites Congress (ICC)

At this year's Composites Europe (29.11. – 1.12. in Düsseldorf) the Composites Germany trade association will be represented with a community stand for the first time. The umbrella organisation of the German fibre composites industry with the members AVK, CCeV, CFK-Valley Stade and VDMA AG Hybride Leichtbau Technologien will be exhibiting on a 350 square metre collective booth which includes a total of 18 member companies.



The exhibitors at the Composites Germany Pavilion include, among others, KraussMaffei Technologies, Dassault Systems Deutschland, Siemens, Olin Epoxy Stade, Institut für Verbundwerkstoffe Kaiserslautern and Leichtbauzentrum Sachsen. Overall, this year's Composites Europe expects to see 350 exhibitors from 20 countries. The focus of the trade fair is on technology and trends in the glass, carbon and bio-fibre reinforced plastics sectors.

2nd International Composites Congress (ICC)

After the great success of the 1st International Composites Congress held within the framework of the past Composites Europe in Stuttgart, the trade association Composites Germany will be holding the next congress on 28.–29.11.2016 in Düsseldorf – again in time for the start of the trade fair. Partner country this year is Japan which will be represented by numerous exclusive speakers.

Under the motto "Composites – On the path to becoming a key industry", 30 international speakers will be presenting the current trends and developments in the fibre composites/composites sector of industry. New applications and technologies as well as a comprehensive overview of market developments in Europe and around the world show that composites are playing an increasingly significant role in light construction.



NETWORK

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CCeV CALENDAR

In this edition of our magazine you find a calender for 2017 with all the important events and dates of our network. Free offer for our members: If you want to get such a calender for your office wall, same entries but bigger in size, please contact us: doris.karl@carbon-composites.eu

"EXPERIENCE COMPOSITES": A PROMISING START

175 exhibitors and more than 4,000 visitors at the kick-off in Augsburg

Augsburg. The new leading international fair for fibre composites, light construction and carbon, "Experience Composites – powered by JEC Group", celebrated a promising start. After the premier of the event, the creators, Messe Augsburg, the French JEC Group and Carbon Composites e.V. (CCeV), are satisfied to look back on a successful start. 175 exhibitors and 4,120 visitors from more than 30 countries, three congresses and multiple side events, awards and a programme for schools made the fair, held 21st-23rd September in Augsburg, a real success story.



Alexander Gundling, CEO of CCeV, is thrilled by the success of the premier: "The concept of a multi-location event was received positively by the members and guests of CCeV. With 4,120 visitors at the initial event, we are more than satisfied. We are also pleased with the fact that most visitors had a very professional background. With this as our basis, I expect to see a considerable growth in the number of both exhibitors and visitors in 2018."

As the European fibre composites hub the city of Augsburg proved to be a first-class host for the international world of light construction and composites. The whole region took the chance of presenting itself as a networking and business kingpin for both small and large companies in the fibre composites community. All of the events were received well, in particular, the 8th user conference of the Tudalit e.V.. Numerous participants also attended additional events, seminars and visited companies and institutes. "I am particularly pleased with the response to the programme for schools. 802 pupils from the region were amazed by the innovative forces behind resource-efficient materials. This is a peak value", says Katharina Lechler, who within the CCeV is responsible for education.

Within the framework of the CCeV Symposium, Carbon Composites e.V. (CCeV) awarded Michael Wilhelm the 2016 study prize for best bachelor thesis and Anja Nieratschker was honoured for her excellent master thesis. The laudation was held by Dr. Tilo Hauke, head of company research at SGL Carbon and member of the board of CCeV.

Six trail-blazing products and solutions received awards within the framework of the "Experience Composites 2016 Innovation Award". The awards, designed by Carbon-Werke Weißgerber using used parts of a wind power system blade and Formula 1 composite materials, were given to Fisco (in the construction and engineering category), Mercedes AMG (automotive and transport category), Cruing (aviation and aerospace category), Cetim (mass production category), M & A Dieterle (equipment category) and the IFB-Institut of Stuttgart University (automation category).

Three startups were honoured with prizes in the first "Startup Awards" under the patronage of Ilse Aigner, the Bavarian minister for economics. The twelve entrepreneurs from six countries presented themselves on their own stands in the Startup Village which was located in Hall 3. They each gave a tenminute pitch presentation to a jury of six. Two first prizes (each liaised with 5,000 euros) went to Cobratex from Toulouse (manufacturer of composites products made from bamboo) and Cevotec (market leader in Fibre Patch Placement technology). The third prize (an office for a year at Technologiezentrum Augsburg) was awarded to the startup Sicony.

The highlight for next year will be the CCeV general meeting on 7th March 2017 celebrating ten years of CCeV and the next international symposium in Augsburg in November 2017 which will be organised by CCeV. The second "Experience Composites – powered by JEC Group" in Augsburg will be held 18th – 20th September 2018.

Acclaimed opening of the first "Experience Composites": Prof. Dr. Hubert Jäger, chair of the board of CCeV, Gerhard Reiter, CEO of Messe Augsburg, and Fréderique Mutel, president and CEO of JEC Group, (center) cut the green tape



CONSTRUCTION MATERIALS NEWCOMER

Kick-off event on the application of Textile Reinforced Concrete

Parallel to the Experience Composites Trade Fair from 21st-23rd September 2016 in Augsburg, the 8th user conference of the Tudalit e.V. took place. Some of the branch attendees took the opportunity, on the third day of the trade fair, to inform themselves about the relatively new material, Textile Reinforced Concrete, at the kick-off event "Carbon fiber applications in the construction industry".

Dipl.-Wirtschafts-Ing. Knuth Ensenmeier, responsible partner for Innovation & Technology at the HWK Schwaben, guided through the event. Dr.-Ing. Silvio Weiland summarised the history of the relatively new construction material and the new possibilities this has opened up in the construction sector for the interested "newcomers" among the attendees. The Tudalit e.V. employee and head of QS, Bilfinger Instandsetzung GmbH, Hamburg, titled his presentation programmatically "More than 20 years of Textile Reinforced Concrete – a German success story".

Well and good

The practical side was the main focus when Bernhard Kölsch, craftsman, artist and founder of the Concrete Factory, cast two Textile Reinforced Concrete components, directly on site. While doing this, the national BMWE award winner for 2016 chatted entertainingly about the constructional and design benefits of this "underestimated material". He also invited the audience to feel free to lend a helping hand in his process. We would like to express our gratitude in this regard to Dr. Michael Kögl and Renate Brechenmacher from the Bauinnung Schwaben who prepared the site, and provided a specialist for support.

In theory and practice

Following this, there came some very informative presentations and reports from the practical side. These ranged from "Lightweight construction application in shell structures from carbon concrete", which Dr.-Ing. Sandra Gelbrich, Head of the research center "lightweight construction" of the Institute for lightweight structures in the TU Chemnitz presented, up to the practical



Textile Reinforced Concrete opens up new possibilities

building presentation "Textile Carbon Reinforcements in concrete construction" from Dipl.-Ing. Ammar Al-Jamous, departmental managing director of CC Tudalit. This was complemented by "Development and Measuring of Carbon Reinforcements – Prognosis and Development" by Dr.-Ing. Harald Michler from the research group Textile Reinforced Concrete, at the institute for solid construction in the TU Dresden.

"Application possibilities of Textile Reinforced Concrete" was presented by Dr.-Ing. Christian Kulas, Departmental Head of Textile Reinforced Concrete at the Solidian GmbH. A wonderful example of this is to be found at the companies' headquarters in Albstadt, a 15 m long pedestrian bridge, the first in the world to be constructed purely from Textile Reinforced Concrete. During his talk "Textile Reinforced Concrete from the local authorities' perspective" construction mayor Dipl.-Ing. Udo Hollauer was very convinced that pure Textile Reinforced Concrete applications were appropriate when one thinks sustainably.



Practical use of the new material was also shown

Spread throughout were numerous addresses like that from Roy Thyroff from Fraas Solutions in Textile for the Tudalit e.V., or Oliver Heiss for the Bavarian Architects Chamber and from Dipl.-Ing. (FH) Ralf Wulf from the Building Divison of the city of Munich for



With a loud blast of the carbon trombone from CCeV member Nägeli Swiss AG, Prof. Dr. Hubert Jäger, chair of the board of Carbon Composites e.V., opened the symposium at "Experience Composites 2016". the Bavarian Engineers Chamber. Dipl.-Ing. Klaus Posset explained the details about "Mae West – a complex art work from Carbon Fiber Reinforced Plastics", especially on the problems of the final assembly at temperatures of about -20°C. Another practical construction presentation was "Restoration measures in a sugar silo using Textile Reinforced Concrete" (Dr.-Ing. Silvio Weiland), followed by the challenges of "Redesign of the State Opera House Berlin" (Dipl.-Ing. Andreas Ehrlich, TU Chemnitz), and the vision of the movable "Self supporting Island Arcoval" from Martin Maria Daum (Architekturbüro Purist, Karlsruhe).



On site Bernhard Kölsch cast a tile with Textile Reinforced Concrete

Summary

What was notable was that the presentations, although they were not coordinated in advance regarding content, resulted in a comprehensive, complementary, unified experience. The event was highly successful, even if more participants would have been welcome, perhaps from the large craft businesses.

A heartfelt thank you goes to all those involved for their efforts. They contributed to more applications for Textile Reinforced Concrete, to an appropriate growth of experience and therefore to the achievement of our common goal "Convince planners and local authorities". An important step in this direction is also the availability of the prototype of the "Planner portfolio" from the editors Dr.-Ing. Ingelore Gaitzsch and Prof. Peter Offermann.

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175 exhibitors were present at the first fair on composites in Augsburg.



802 pupils visited the fair, where the CCeV Study Prize was awarded for the third time.

SPECIALISTS ON DESIGN TOOLS MEET

Theme day "From design dimensioning via design verification to certification"

During the "Experience Composites"-fair there was also a CCeV-theme day on the topic "From design dimensioning via design verification to certification". Professor Ralf Cuntze from Carbon Composites e.V. (CCeV) organized this event and invited specialists on design tools, applicable along the design development chain.

Prof. Ralf Cuntze, retired from aerospace industry and presently heading the CCeV workgroup "Engineering", opened the workshop with a presentation with the title "From design dimensioning via design verification to product certification with emphasis put on composite parts development" as a general introduction to the contents and title of the workshop. Dr. Robert Boehm (ILK, TU Dresden) followed with a presentation on "Novel material models and multi-scale simulation methods for composite materials". Materials addressed were the "simple" UD material and basic textiles.

Dr. Christian Huehne from the Institute of Composite Structures and Adaptive Systems, DLR, Braunschweig talked about the "Simulation of manufacturing processes": Process simulation, well connected to structural analysis, is a precondition for reliable designing, was his message. Design results, obtained in the MAI Carbon Cluster research project, were presented by Dr. Roland Hinterhoelzl (LCC, TU Munich). Again, connecting process simulation to structural analysis was addressed as a presently main design feature.

Excellent joints and load introduction elements are key enablers for high performance structural parts. Therefore, Professor Helmut Rapp (UniBw, München) presented ideas on "Load introduction in monolithic and hybrid lightweight structure".

Structures may suffer from repeated loading which may lead to fatigue problems. Dr. Ilja Koch (ILK, TU-Dresden) and Prof. Peter Horst (TU Braunschweig), both members of the German fatigue working group "BeNa = Betriebsfestigkeits-Nachweis", reported on their view of the lifetime prediction status. The presentation on "Strength and curing simulation of thick-walled composites with ANSYS WB 17.0" by Rene Roos (ANSYS Switzerland) and Cédric Devivier (LMAT Ltd. Bristol) stated that structural parts can be thick-walled, which requires a much higher analysis effort. This begins with an optimized curing simulation to keep residual stresses low.

Prof. Martin Schagerl (JKU University Linz, Austria) then gave insight to the structure of the German Aeronautical Handbook HSB, enriched with presently prepared "Current contributions and research activities on fundamentals and methods for structural design and analyses". Valuable theoretical HSB design sheets, parts of this excellent design handbook, will shortly become available via Internet for every engineer. First failure is not last failure, residual load and stiffness capacities still exist. Dr. Matthias Hörmann (CADFEM GmbH, Grafing) showed in his presentation "First-ply-failure and then what? – Approaches for detailed simulation of failure" what is left after initial failure occurred – important insights to avoid a costly design change in the case of an unforeseen overloading.

Horst Bansemir (formerly Eurocopter Germany, Ottobrunn) closed the workshop with a standard rules-based report on "Certification aspects" in airplane design when composites are used. It is based on his contribution to the FAA-rule "Damage tolerance and fatigue evaluation of composite rotorcraft structures".

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TOGETHER

CCeV themed day "Functional integration in practice" at BMW in Leipzig

The two CCeV workgroups "Multi-Material-Design" and "Smart Structures" came together for the first time, in cooperation with the PolymerMat e.V. for a joint themed day at BMW in Leipzig. More than 70 participants from both industry and research joined the event.



The guests were welcomed by representatives from the CC Ost and CC West departments, Dr. Thomas Heber (departmental head for CC Ost and workgroup leader for "Multi-Material-Design") and Dr. Martin Gurka (workgroup leader for "Smart Structures", CC West). The opening lecture was held by Dr.-Ing. Johannes Voigtsberger (head of Integration of production projects at BMW i, BMW factory in Leipzig and member of the board of CC Ost), who used the one hundredth anniversary of the company to take a look at BMW developments and offer an overview of the mobility concepts of the future. A tour around the BMW factory provided a comprehensive overview into the serial production of BMW's electric vehicles i3 and i8 and completed the program of the host.

In the afternoon session of the CCeV themed day, the participants investigated the topic of functional integration: The incorporation of multiple passive, active or sensory functions in a single component makes the component itself more complex, but reduces the number of components within the system as a whole. Costs, manufacturing expenses, installation space and weight can be saved using elegant functional integration.

The general approach, which is considered the aim within the design of functional integration, is to map as many technical functions as possible with as few components as possible, is shared by the specialists, but they believe it can be broadened: Only by observing the system as a whole is it possib-



Fahrzeugbau Meier GmbH presents the prototype of a camper with a functionally integrated GRP chassis.

le to take into account all of the constraints that are necessary to achieve sensible functional integration.

Herwig Kirchberger from Teufelberger Composite GmbH reported his experiences in this area: According to Kirchberger, if you combine the knowledge gained from metal-composite-light construction with solutions from the electronics industry, and then draw on user experiences from both sectors, functional integration can be implemented successfully.

Wolfgang Schlick from Fahrzeugbau Meier GmbH presented a patented new development: an innovative GRP chassis for camper vans and commercial vehicles that has been developed in conjunction with the professor for plastic technologies at TU Ilmenau. The participants were able to view the camper prototype on site.

"It is impressive to see the variety of innovations being made in the fibre composites sector, both at BMW in Leipzig and at smaller companies, such as Fahrzeugbau Meier GmbH", concludes Dr. Thomas Heber: "Even beyond the automotive industry, for example, in machine and system construction, there are considerable potentials waiting to be exploited by our members."

11th INTERNATIONAL CARBON FESTIVAL

A delegation from the leading edge cluster MAI Carbon were guests in Jeonju, South Korea

A 22-man delegation made up of members of the leading edge cluster MAI Carbon, an initiative of the Carbon Composites e.V., travelled to South Korea to participate in the 11th International Carbon Festival in the provincial capital Jeonju, 230 km south of Seoul.



The invitation came from the South Korean Carbon Cluster, in cooperation with KOTRA, the Korean Trade Agency, Hamburg.

Alongside the opportunity for the MAI Carbon partners to present itself as an exhibitor and to establish Korean business contacts, there was also the parallel opportunity to hold presentations as part of the 2nd Global Carbon Cluster Forums. Among other things, presentations were on offer giving the newest results from the companies BMW Korea and ARRK P+Z Engineering, as well as SGL Carbon Meitingen, the University of Augsburg, ELG UK, TUM, Fraunhofer IWU, ILK of TU Dresden, DLR, Premium Aerotec, Voith Composites, Quickstep, BA Composites, Saertex, Krauss Maffei and the leading edge cluster MAI Carbon. As a finale, the research centre KCTECH was visited.

The Korean government sees lightweight construction as an important future branch and has set up corresponding funding opportunities. KCTECH, which is mainly



The delegation in front of a temple of the traditional Hanok houses in Jeonju.

focussed on the topics of Composite Materials and lightweight construction has profited from these measures and has equipped itself with cutting edge technology for research purposes. Afterwards there was an opportunity to get an introduction to the cities history before travelling to Seoul to begin the journey back to Germany.



MAI Carbon participated in the 11th International Carbon Festival

In conclusion it can be said that the trip served the purposes of mutual exchange and deepening of contacts for further cooperation. The excellent organisation made it easy for the participants to get to know this distant country and to return with a positive impression.

"THE FUTURE IS COMPOSITES" – FILMED BY CCeV

CCeV is producing its first own video on the various steps of the making of products with carbon composites. Filmed at the Textilmuseum Augsburg, where an exhibition on the topic was taking place until the beginning of November, the production wants to bring the fascination of carbon composites to young people. The video will be available on the website of CCeV by the end of 2016.





TEN YEARS OF CCeV – SAVE THE DATE

On 7th March 2017, members of Carbon Composites e.V. (CCeV) are invited to join the 10th general meeting of the organisation. Please note the date in your diary – an invitation via mail will be following soon.

THEME DAY IN AUSTRIA

CCeV discusses "Reliability and durability of CFRP components"

In September 2016, the company CoLT Prüf und Test GmbH at St. Martin im Innkreis in Austria held the CCeV theme day "Reliability and durability of CFRP components" of the technical engineering workgroup of the regional department CC Austria and Carbon Composites e.V. (CCeV).

Workgroup leader Dr. Markus Wolfahrt (AG Engineering/CC Austria) and Dr. Christoph Schöndorfer from host CoLT Prüf und Test GmbH welcomed 50 participants to the event. Main focus of the event was to bring together experts from Austria, Germany and Switzerland to initiate further engineering and scientific innovations in the field of reliability and durability of composite materials.

After a short introduction, Prof. Ralf Cuntze (CCeV), Prof. Clara Schuecker (Montanuniversitaet Leoben) and Martin Schwab (Technische Universität Wien) spoke about modelling approaches modelling approaches for fatigue damage in fiber-reinforced composite materials. In addition, Dr. Christian Gaier (Engineering Center Steyr) presented a software-based method for the fatigue strength analysis of structural components. The lectures given by Dr. Steffen Stelzer (Montanuniversitaet Leoben) and Jörg Goessl (CoLT Prüf und Test GmbH) concentrated on the experimental characterisation of composite materials under fatigue and multi-axial loading conditions. Prof. Martin Schagerl (Johannes Kepler Universität Linz) discussed "Structural health monitoring" of light constructions, Horst Trattnig (Vallen Systeme) offered an overview into the non-destructive materials testing of CFRP components. The series of lectures was concluded by Florian Röper (Polymer Competence Center Leoben) with his lecture on adhesively bonded repairs for aerospace composite structures.

The theme day was closed with a guided tour of CoLT Prüf und Test GmbH Colt and

FACC Operations GmbH. As the day came to a close, all participants could look back on a successful CCeV event with many key impulses for their future work.



50 participants visited the CCeV theme day "Reliability and durability of CFRP components".

NEW CCeV-MEMBERS

compositeworx

The Heinrichwerft shipyard at Lake Constance is one of the leading developers of lightweight building materials. The company has accumulated extensive knowledge over the years, which it offers through compositeworX to customers in the maritime industry, wind energy, specialised vehicle construction and architecture. Heinrichwerft offers advice and assistance in relation to composite technology applications, the development of mould concepts and modularisation, as well as mould construction and the manufacturing of entire products.

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NIEKE COMPOSITES

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Composites Busch is a specialist provider of high performance composite solutions for a range of industries and applications. For over 25 years the company has been creating customer value for leading manufacturers in the areas of medical technology and devices, industrial manufacturing, 3D additive manufacturing, and luxury and sports goods. Solution-driven collaboration with its customers is one of the company's greatest strengths. Composites Busch is certified according to ISO 13485 for the applied research and production of medical devices.

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ANNUAL KEY TOPIC "RECYCLING"

With this issue of the "Carbon Composites Magazin" at hand we complete this year's annual key topic "Recycling".

A compilation of all our magazine articles dealing with this topic during this year 2016 will be available as of the beginning of next year. For further information on this behalf please contact: Doris Karl, CCeV, phone +49 (0) 821 / 26 84 11-04, doris.karl@carbon-composites.eu

Please note: the annual key topic for the upcoming year 2017 will be "Design".

TOMORROW BEGINS TODAY

Recycling of composites - a perspective for the future

Building up a resource efficient materials cycle is recognised as an effective building block for the further development of Carbon Composites. The solution to this problem is being researched and developed in various locations. The time has come for a comprehensive evaluation, which will enable focusing on the outstanding tasks.

What is vital is a consistent processing concept for the usage of recycled carbon fiber (rCF) materials. The elements are listed below:

Development of a logistics chain for waste recovery

Even when assuming an increased market volume this task can be quickly implemented by efficient partners from the waste logistics sector, based on a meaningful classification of the waste.

Separation Matrix – Fibers

Basically the research into better processes for the separation of fibers from resin-based waste (processing and end-of-life) should be continued. However, it can and must be noted that there is an already existing practice carried out in several industrial installations with pyrolysis, which results in the fact that rCF materials can be further processed.

Establishing of semi finished products

The application of nonwoven processes have led to an industrially capable and, above all, an economically efficient process for the creation of semi finished products.With continuous improvement this should form a good basis for applications in lightweight construction. The sensible adjustment to the product characteristics will lead to a suitable basis for an appropriate design of the



Application of web based composites



Compact line at ITA: carbon fibre waste to semifinished products for hybrid, thermoplastic and thermoset materials

end products. The high degree of variation, which results from process of "web based composites" is a system benefit which will enable further interesting applications. In special cases, yarns and other products like patch-based surfaces, will complement the areas of application.

Step-by-step Downcycling

Obviously it will not be possible to avoid a certain deterioration in the fiber characteristics after recycling. However the choice of the correct process has to orient itself to the challenge of negatively influencing the fiber characteristics, and especially fiber length, as little as possible. From this point of view, the process of chopping waste pieces of several hundred millimeters in length, into ultra short fibers is a destruction of value which is avoidable. Although it must be taken into consideration to find a reasonable solution for the high degree of dust created in the processing of rCF.

Norms and Standards

The well-directed development and trading of products along the value chain of rCF must be based on reproducible and aligned standards and testing devices. Developing these must be a key focus for the near future.

Products and applications

The products determine the appropriate processing technology for rCF. The systematic search for suitable applications must be led by this seemingly obvious but however very important recognition. There are more than enough application examples, which would provide a good and suitable basis for the characteristics of rCF products.

Design processes for rCF

Proper application of rCF materials in composites calls for appropriate layout and calculation models. Especially for nonwovens there is a lack of specific but straightforward models, which can be adapted by designers in medium size and small enterprises, too. Application based semi-finished products like profiles, tapes or organo webs may support this measure.

Pilot applications

Nothing convinces potential users as much as the demonstration of successful applications. This requires a comprehensive approach in combination of process technology and product development, like it is possible with the industrial scale compact line at ITA Augsburg.

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NEW SOLUTIONS

Cross-Cluster project started by the environment cluster Bavaria and the leading edge cluster MAI Carbon

The Environmental cluster Bavaria, together with the leading edge cluster MAI Carbon, which is an initiative from Carbon Composites e.V. (CCeV), have embarked on a Cross-Cluster Project on the topic of waste disposal and recycling of waste containing carbon fibers.

UmweltCluster Bayern •



The project has the aim of identifying and further developing intelligent and sustainable solutions for the waste disposal and recycling of residues containing carbon fibers. A sustainable basis should be created which will set processes in motion over the course of this one-year project (Start 1st October 2016) that will further develop and anchor the recycling of CFRP materials in Bavaria. The total funding amounts to 50,000 Euro, which will be divided equally and refinanced.

Carbon fiber reinforced plastics (CFRP) are implemented everywhere when lightweight construction and stability play an important role. Based on their enormous potential in lightweight construction, they are a vital component in the most varied of branches, like for example the automotive, aircraft and aerospace industries. The growth in production levels has naturally led to an increase in the amount of waste produced containing carbon fibers. There do, of course, exist methods of waste disposal and recycling of CFRP, however no process has established itself on the market. Therefore the necessity is there to examine, further develop and, where appropriate, to identify new possibilities for waste disposal and recycling.

The focus of the project lies on the analysis of challenges and specific competences of the members and partners of the Environment cluster Bavaria and MAI Carbon. The project bundles the know-how of two strong networks and will therefore make a strong contribution towards strengthening Bavaria as a location as well as dealing with an important future challenge. The Bavarian ministry of Finance, Media, Energy and Technology is funding the project.

The Environment cluster Bavaria is the network of Bavarian environmental economics and science. The work of the network aims at the strengthening and expansion of en-



The MAI UCB project team is striving to identify and further develop intelligent and sustainable solutions for the waste disposal and recycling of residues containing carbon fibers: Anna-Lea Glocker (MAI Carbon), Denny Schüppel (MAI Carbon), Laura Jantz (Environment cluster Bavaria), Stephanie Schwarz (Environment cluster Bavaria), Daniela Ratzinger (Environment cluster Bavaria), Michelle Kraus (Environment cluster Bavaria) (f.l.t.r.)

vironmental technology in Bavaria through interlinking, informing and increasing cooperation. The Environment cluster Bavaria bundles the Bavarian competences from the sectors of water and sewage, waste and recycling, energy production from waste and biomass, air pollution control, resource efficiency and material flow management. Additionally the Environment cluster supports Bavarian companies in their efforts in the international environmental technology market.

MAI Carbon is one of five leading edge clusters that were recommended for funding from the Federal Ministry of Education and Research in the third round of the leading edge cluster competition in 2012. The cluster, based in the triangle covered by Munich, Augsburg, and Ingolstadt, has the target of leading CFRP technology to large series production status by 2020. This should lead to Bavarian industry in particular being strengthened and to an expansion of the innovation lead already existing within many companies. In order to reach their goals, springboard innovations are required along the complete component life cycle i.e. starting from the fiber and matrix material to the production of components and product systems and on to coherent recycling concepts. To these ends MAI Carbon has initiated numerous R&D projects, which will have effects along the complete value added chain.

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HOLDING UP

Fully recyclable high pressure composite tanks made with thermoplastic resin

With its thermoplastic matrix made of polyamide and a liner made of the same material an innovative pressure tank is fully recyclable, whilst at the same time providing for extremely short cycle times due to an innovative manufacturing process. The concept was developed by the Darmstadt based Engineering Service Provider compoScience GmbH.

Pressure tanks made in CF/EP wrapping technology are state of the art and have been used industrially for many years. Their increasing application as fuel tanks in the automotive sector, however, raises new issues in connection with the recyclability of these material systems. The mixture of thermosetting composite and thermoplastic liner used currently allows only the thermal recycling of the costly CFK material.

An innovative pressure tank concept developed by the Darmstadt/Germany based Engineering Service Provider compoScience GmbH to be showcased at this year's Composites Europe is now promising to provide a solution to this dilemma. With its thermoplastic matrix made of polyamide and a liner made of the same material, the pressure tank is fully recyclable, whilst at the same time providing for extremely short cycle times due to an innovative manufacturing process.

Bonification scheme

The process is essentially not much different from the traditional wet wrapping process using epoxy resin. Standard wrapping equipment merely needs to be supplemented with a temperature-controlled enclosure for the wrapping space and a special system for impregnating the reinforcing fibers.

The really outstanding feature of the process lies in that instead of the conventional high-viscosity polyamide melt, fibers are impregnated with the low viscosity precursor product Caprolactam; polymerization to obtain the finished matrix material does not take place until after placement of the fibers on the winding core. As impregnation of the fibers takes no more time than in the case of conventional thermoset wrapping, manufacturing



Thermoplastic composite tank with cut-trough dome

times are comparable. In addition, the tempering process which is mandatory for thermosets, is no longer necessary. Particularly in the case of large-volume tanks manufactured in high quantities for the elimination of this time and energy consuming temperature process may provide substantial cost benefits.

Goings-on

Currently, a laboratory facility operated by compoScience GmbH, which was adapted to the new wrapping process using Caprolactam allows wrapping and curing of prototypes to be accomplished within just a few minutes.

The mechanical properties of the CF-PA composite, such as strength and stiffness, have been shown to be comparable to those of composites made with epoxy resin. As had been expected, the more ductile thermoplastic composite was even found to be more tolerant under impact loading than its more brittle thermosetting counterpart.

The development team at compoScience is currently working on empowering the process for typical wrapping applications hitherto using exclusively thermosetting matrices. At the Composites Europe show in Düsseldorf/Germany, the company is also hoping to find a project partner to jointly promote the further development of this novel technology.

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LAYOUT & CHARACTERISATION

SPIRALLING FREEDOM

Continuous shape ribbon for production of frames

Gerster TechTex, a business unit of Gustav Gerster GmbH & Co. KG, has a strategic focus on reinforcement textiles in general and on near-net-shape preforms. Gerster TechTex strives to create textiles for more efficient processes in component manufacturing and for reduced waste cut. Newest product in this line is a continuous shape ribbon.

The new product shape ribbon aims at reproducing larger free-shape geometries in a continuous process. Larger preforms were not feasible to date. Typical structures are frames, doors, windows and local reinforcements of cabins (cars, trucks, trains, helicopters, airplanes), potentially also curved springs.

Woven ribbons

The weaving process itself is based on a newly designed textile machine based on ribbon weaving. Shape ribbons may be supplied in two ways, as closed frame structure, or as single free-shape coupons. A preform consists of any number of layers. Curvature can take any direction, also Sshapes, as component geometry demands.

Fibre orientation follows shape. A multilayer shape ribbon preform consists of endless fibres following shape by 0°/90° orientation (or alternatively purely 0° or 90°), i.e. at the correct length fitting to the shape. These characteristics improve mechanical properties compared to precut textile sheets, offer further potential to reduce component weight and make more efficient use of fibres, which is especially beneficial for carbon fibre products.

Multi-purpose fit

Edges are closed and defined. Weaving style may be locally adapted to improve drapability where needed. Both features help to enable an accurate placement into the mould without waste cut and simplify steps in automated production. The new shape ribbon makes a major contribution to increased manufacturing efficiency and specific use of fibre properties by its nearnet-shape quality, optimal fibre orientation and endless fibres.



Application examples in automotive industry – ribbons can be woven directly to product shape

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Curvature of the continuous shape ribbon can take any direction, also S-shapes



Close-up of the woven ribbon structure

EXCEPTIONAL OUTLOOK

Multi-scale visualisation - key to an enhanced understanding of materials

Now it is possible to implement a user-friendly cross-model concept which enables the multi-scale visualisation of individual sets of simulation results. It was jointly developed by the Institute of Lightweight Engineering and Polymer Technology (ILK) and the Chair of Computer Graphics and Visualisation (both part of TU Dresden) within the framework of ScaDS Dresden/Leipzig – Competence Center for Scalable Data Services and Solutions.

Computer-assisted methods play a vital role in the cost- and material-efficient design of lightweight structures, and are set to become an even more integral part of the development process in the future. In the case of fibre-reinforced composites, it is crucial that designs take their entire hierarchical structure into account – from fibres, matrices and rovings to reinforcing textiles, individual layers and multi-layered composites.

This hierarchical approach also needs to be applied as components are joined to form structures and multiple structures interact within the overall system. The availability of a suitable simulation model for each scale is therefore a prerequisite for targeted, efficient system development.

In any case ...

The here presented solution is the first to facilitate the consistent visualisation of simulation results across all scales (Fig. 1). The browser-based software demonstrates the potential offered by multi-scale visualisation in terms of gaining an enhanced understanding of material behaviour. The example presented here uses simulation data generated during the development of an adaptive leaf spring within the framework of special research project SFB 639.

... and scale

As in the case of conventional tools, the software provides users with a 3D visualisation of previously computed results at the selected point in the loading process (Fig. 2). What is more, its zoom function is the first to enable users to switch between scales – and therefore between different sets of simulation data. Once a specific zoom value has been reached, the software automatically switches to the next coarser or finer scale while remaining at the same point in the loading process (Fig. 3). The continuous fade between scales (i.e. there is no cut in the zoom process) ensures that users do not become disoriented.

Data on demand

The browser-based software can be used on any platform and does not need to be installed – all of the data required is available



Fig. 2: A rough 3D model of the demonstrator vehicle illustrates the application environment into which the simulated leaf spring is integrated.



Fig. 1: Multi-scale concept – Simulation and visualisation of material behaviour from individual fibre to overall vehicle.

on a web server. The resultant avoidance of time-consuming data loading and program installation processes also ensures the rapid presentation of simulation results. The interface can be operated using a mouse or touchscreen, thus guaranteeing simple, efficient interaction with the software on a variety of devices.

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Fig. 3: Left: Zooming in makes it possible to view the material stress at mesoscopic scale (textile). Right: By zooming in again the material can be viewed at microscopic scale (fibres/ matrix) at the same point in the loading process.

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Fixture for the efficient unrolling of glass rovings without core

Glass fibers are intended to be processed in a great many fiber composites, which are normally intended for center-pull due to their production-related coil geometry. But as it is particularly Important in the production of many fiber composites that the fibers don't have any twists through the pull, there was a great need for alternative unwinding methods. At TEXMER, we are always interested in providing our customers with efficient and inexpensive solutions for their problems; we have thus invested a lot of energy and time in the development of a suitable product.

Since the introduction of our SKE mandrel just under three years ago, there have been more and

More new processes, in which glass fibers can now be unwound efficiently and inexpensively. The SKE mandrel enables a good torque transmission due to its hexagon receiver. And it therefore also allows for high thread tensions. The dimensions of the holder geometry are adapted to our electronically controlled unwinding units (EGA2000) and our mechanical belt brakes, and thus enable an unwinding process with a constant thread tension from the full to the almost empty glass fiber roving.



Technical data:

Maximum Roving Weight: 20kg Maximum unrolling speed: 180m/min Tension range for inside roving diameter: 145-175mm Maximum input pressure for pneumatic cylinder: 6bar

If we have sparked your interest and if you are looking for a Simple affordable and efficient solution for unwinding glass fiber rovings, please feel free to contact us. We'd be happy to present you with an offer for our products.



NEXT GENERATION SANDWICH PANELS

Comprehensive research and technology enables new kind of sandwich panel manufacturing

With a combination of six new technologies the Composites Manufacturing Lab (CML) at the GE Global Research facility in Munich proves a novel concept for the manufacturing of sandwich panels. The process involves forming of dry fiber Automated Fiber Placement (AFP) as well as stitched foam cores and Fiber Patch Preforming.

The use of sandwich panels is very common, especially in the wing section of aircraft. Currently, GE Aviation at Hamble (UK) manufactures aircraft sandwich panels with prepreg fabric material and honeycomb cores. Those panels consist of four independent parts: core, under-core plies, socalled picture-frame plies and over-core plies. In the 'Next Generation Sandwich Project' the CML in Munich is supporting GE Aviation to automate sandwich panel manufacturing by investigating potential novel technologies:

- The new core material used is Tied Foam Core developed and manufactured by the Airbus Group. This core uses a standard Rohacell foam material that gets stitched with undrilled rovings to adjust mechanical properties.
- 2. Both under-core and over-core plies have been prepared as flat stacks made with dry fiber AFP. Thereby, the process leverages the advantages of the technology: high accuracy and layup speed, low waste, short process times

and the opportunity of forming flat parts in a second process step. Those flat stacks have been manufactured by the Fraunhofer Institute in Augsburg.

- 3. For the picture-frame plies, Fiber Patch Preforming (FPP) is used as the process is not limited by a minimum cutting length. The FPP layups have been prepared at the Technical University of Munich (TUM) in cooperation with the LCC (Lehrstuhl für Carbon Composites) as well as the company Cevotec.
- 4. The over-core plies are brought to their final three-dimensional shape by a thermoforming process that has been developed in cooperation with Coriolis Composites. All trials have been conducted on equipment which involves an IR-heating field and uses a metal die forming tool that has been developed at GE. The development of the panel thermoforming has been carried out within a master's thesis by Anja Nieratschker and has been awarded the CCeV study prize 2016 in the category Best Master's Thesis.
- 5. To minimize manual labor in the process all parts are assembled automatically before infusion. This part of the project has been done on a conceptual basis by GE. The concept for the automated assembly involves automated positioning of all parts, as well as the application of auxiliary material and infusion of the panel.
- 6. The infusions of the assembled panels have been done with a Vacuum Assisted Resin Infusion process (VARI) to utilize the flexibility of the process and save tooling cost. All infusions have been done internally at the Composites Manufacturing Lab at GE Global Research in Munich.

These six novel technologies have been investigated at a representative generic sandwich geometry provided by GE Hamble. This generic geometry involves characteristic features of different typical aircraft fixed trailing edge wing panels and is thereby well suited to show the feasibility of the process. Starting on a subscale le-



Setup of the investigated sandwich panels

Overview of novel manufacturing process developed at the Composites Manufacturing Lab of GE's Global Research Center in Munich

vel, further development led to full-scale trials and finally two full-scale demonstrators have been manufactured. A proof of concept has been demonstrated and follow-up projects are already discussed with GE Aviation.

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Anja Nieratschker (left) was honoured for her excellent Masters thesis. The laudation was held by Dr. Tilo Hauke (right), head of company research at SGL Carbon and member of the board of CCeV.

The Next Generation Sandwich Project is an interdisciplinary research project led by GE in cooperation with the TUM, Cevotec, Airbus, Coriolis Composites and the Fraunhofer Institute in Augsburg.





ALL-IN-ONE-TECHNOLOGY

Fully automated design and manufacturing of complex geometries with dry fibers

While the automated processing of fiber composites with resin injection processes like RTM is already industry standard, efficient and automated fiber placement processes for complex geometries are still challenging. Until now, narrow radii and angles, strongly convex and concave shapes and undercuts are a challenge for every fiber composite engineer when faced with automation for high volumes.

The start-up company Cevotec rises to this challenge and developed the first fully automated production line for complex geometries based on Fiber Patch Placement (FPP) technology.

Made to order

The robotized system is the first of its kind for scalable serial production of high-quality, complex CFRP components. Three dimensional geometries are directly produced, making additional forming processes obsolete. The additive manufacturing process of FPP applies fibers only where they are necessary. Thus, variable wall thicknesses in the component and net shape preforming are implemented with ease. This reduces material input compared to conventional processing methods by up to 30 percent and scrap rate are reduced to about 5 percent.

In addition, Fiber Patch Placement also enables completely new degrees of freedom in the design of load-optimized laminates, as the patches can be placed to perfectly follow load paths in a part. This results in an increase of mechanical properties such as strength and modulus by up to factor 2.5x compared to standard layups.

Artist at work

The intelligent core of the new technology is the software platform Artist Studio developed by Cevotec. It consists of two modules. Module 1, the Patch Artist, automa-



Bird's eye view of FPP production system

tically generates intrinsically optimized patch laminates for the CFRP components, based on CAD files. It optimizes the overlap of the patches in the laminate to ideally distribute the gaps and thus improve the mechanical properties of the laminate.

The layup information is transmitted to module 2, the Motion Artist, which generates the machine data for the robot-assisted production process in the new Fiber Patch Placement production system Samba, which Cevotec developed in partnership with Baumann Automation.

The result: stress-oriented, curvilinear fiber laminates with a logical positioning of each individual patch; efficiently and directionally oriented. All of this is documented in detailed protocols, generated during the production process, which also include data from quality inspections of every single fiber patch. This enables a seamless fiber patch quality documentation for the entire part. With this successful synthesis of both software and hardware Cevotec levels the path for a large-scale volume production of complex components for aerospace, automotive and other industries.

Cevotec releases the Samba production system, together with the Artist Studio software, at JEC World in Paris on 14th March, 2017.

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Additive placement of fiber patches

OPEN-DOOR DESIGN

Honeycomb core range broadened with 4 mm cell size in 5 mm and 6 mm thickness

ThermHex Waben's polypropylene honeycomb cores offer today a reduction of costs and weight to a wide variety of applications such as truck and trailer bodies, in caravan industry or manufacturing of prefabricated bathrooms, shower tubs and swimming pools.

Different to the traditional manufacturing of thermoplastic honeycomb cores in discontinuous production processes the continuous ThermHex production process allows for a considerable reduction of production costs and material and energy consumption. Thanks to that, customers of producer ThermHex Waben benefit from a distinct price advantage. Moreover, the continuous production process with integrated recycling of the minimal production waste enables the economical usage of resources and improves the CO2 footprint. Another advantage of the automated in-line production is the automated continuous quality control.

Various benefits

Sandwich constructions with honeycomb cores and the consequently reduced weight have proven to give a positive effect in energy consumption and environmental balance to many applications. The cost reduction in honeycomb core production now enables to combine these advantages with a price advantage and thus use honeycomb sandwich constructions also in cost sensitive applications. The price advantage especially becomes clear for thinner thicknesses, as these require a big amount of production waste and work force when being produced in traditional processes, while the ThermHex production process allows for an efficient production even for smaller thicknesses.

New dimensions

ThermHex Waben GmbH therefore adds to their product range a PP honeycomb core in 5 mm and 6 mm thickness. Next to the known thicknesses of 3,5 mm and 8-28 mm the user is now being offered a bigger choice of thicknesses and further potential for optimization. The new thicknesses also offer an alternative to resin impregnated mat core materials. A comparison of a sandwich made with such a material and a sandwich with the 5 mm ThermHex PP honeycomb core reveals a potential of a weight saving of 14 percent with a cost saving of 28 percent, while the flexural stiffness of the sandwich increases by 50 percent.

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YOU'RE SKIDDING

T-RTM lauded perfect combination for modern lightweight construction

Continuous fibers, short cycle times, welding and recycling capability: KraussMaffei's Thermoplastic Resin Transfer Molding (T-RTM) procedure unites the benefits of reaction process machinery, thermoplastic materials and shaping in the RTM procedure.



The new RimStar 8/8 T-RTM metering system enables on-demand melting of the caprolactam components.

Promise goes: short cycle time for automotive component in hybrid design made of fibers, plastic and metal. To prove the real thing lives up to it at the K 2016 trade show booth in October in Düsseldorf, KraussMaffei was demonstrating the production of a fiber composite frame under series production for the roof shell of the Roding Roadster R1 sports car. Partner in developing component design and hybrid concept of this technology demonstrator was Forward Engineering.

This mentioned roof frame is based on a hybrid construction of fibers in conjunction with plastic and metal, making it possible to process both glass and carbon fibers with reliability. The production process at the trade show booth lasted just a few minutes. The system thus demonstrated the feasibility of automated and process-reliable integration of metallic inlays into T-RTM components. The use of what is called the near net shape approach, which takes a part close to its final form, means there is no need for complex post-mold processing such as milling the border area.

Multi-preforms with a hybridized NCF layup

The multi-preform solution with four subpreforms enables a load path oriented layup. This, combined with the high fiber-volumefraction in the T-RTM process, increases the mechanical performance and allows a costdown by substituting carbon with glass fibers. Instead of combining thin glass and carbon non-crimp-fabric (NCF) layers, a hybridization of cheaper heavy tow carbon and glass fibers in one thicker NCF layer is chosen and gives the part its zebra-look. All preforms are net shape trimmed to reduce the material input rate of the fiber reinforcement and to have no resin impregnated fiber waste in the production.

The process integrated metal inlays fulfill the demands for composites. The linkage between the coated inlays and the resin is achieved by adhesion and form-locking. The overflow of the inlays with pure resin prevents galvanic corrosion between the inlays and the carbon fibers.

Melting on demand

An important component of the complete line is the new KraussMaffei RimStar 8/8 T-RTM metering system, which makes the melting process on demand. Only the material for a few shots is melted at a time. This makes it possible to prevent a material aging of the two caprolactam components (caprolactam base material and activator or catalyst) by minimizing the thermal load on the melt. The new metering system also offers outstandingly accurate temperature control, from melting to injection into the cavity. These properties, taken together, ensure consistently higher product quality and thus underscore the suitability for series production.

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In zebra look: Frames for the roof shell of the Roding Roadster R1 sports car – the T-RTM process enables processing of both glass fibers (white) and carbon fibers (black).

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GMA-WERKSTOFFPRÜFUNG GMBH BÜRGERMEISTER-WEGELE-STR. 12, 86167 AUGSBURG TEL.: +49 (0)821 56747-270 WWW.GMA-GROUP.COM Multilayer basalt tube on the spit – aka pushrod

CONTENTS OF MANY KINDS

Multilayer basalt tube suitable for application in demanding settings

With their new multilayer basalt tube Franconian producer CG-Tec and its Austrian development partner NBG Systems GmbH present a type of new composite core. It combines high-performance basalt fiber, high strength stainless steel tubes, a communication element (optical fibers, coax or copper wires) and optionally a polyamide, polyethylene or high-density polyethylene sheath.

This composite cable core has excellent properties including lightweight, high strength, high temperature, lower line loss, small sag.

The cable is based on a new high-tech material, the mineral fibers of basalt, an alkaline volcanic rock. The material was originally intended for the thermal insulation of nuclear reactors, and now it is used as a material mix which practically eliminates cable breakage. Frequent repairs due to cable breakage will now be a thing of the past. Because of its unique properties it is practically indestructible, permanently unbreakable, and still retains its functionality at high temperatures.

One for all

Depending on the task required, the stainless steel metal tube is configured in turn with a varying number of optical and copper conductors for the transmission of control and data signals. Despite its outstanding protective properties, the new hybrid cable is extremely lightweight, unlike armored cables, for example.

Being suitable for application in high temperature, high pressure and high voltage environs the said multilayer basalt tube is intended for use in permanent installations, e.g. in the cabling of buildings or tunnels.



CG TEC fair team proudly presents the CG TEC range of products

Features of basalt fibers

- temperature of application:
 -30 °C up to +70 °C (max. +80 °C)
- weight approx. 31 kg/km
- high tensile strength up to 29 kN
- breaking load up to 12 kN
- rodent protected
- chemical resistant
- bend resistant
- fire-resistant
- natural product
- can be used as a push rod
- optionally available with a polyamide, polyethylene or high-density polyethylene sheath

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STRONGER, FASTER, FLEXIBLE

Expediting induction welding of CFRPC

The application of carbon fiber reinforced polymer composites (CFRPC) in mass production is still hindered by a lack of lightweight and economical joining technologies. Therefore, the Institut für Verbundwerkstoffe (IVW) develops advanced joining technologies for thermoplastic FRPC which provide excellent bonding strengths combined with a high automatization level.

Based on fundamental investigations, several variants of the induction welding process were initially developed for different applications. Due to the special advantages, the induction welding process is quite appealing regarding an industrial application.

Potential tapping

Especially for the continuous induction welding of thermoplastic carbon fiber reinforced polymer composites (CFRPC) the enormous potential of this technology is not completely exhausted yet. Hence, IVW proposes to increase the welding speed at consistent welding quality and to consequently increase the efficiency of this particular process variant. For this purpose a "Process optimization of induction welding of continuous carbon-fiber reinforced thermoplastics by process simulation" is being currently conducted in the context of the same-titled project founded by Deutsche Forschungsgemeinschaft (DFG).

Features	Advantages
Additional materials for welding are not necessary	 + High level of lightweight + No compatibility problems (e. g. corrosion) + No thermal stresses due to different thermal expansion coefficients
Contactless Heating	 + Large geometry freedom of the joining zone + Welding jig is not necessary + Continuous joining is possible
Heat generation inside of the material	 + High heating rates + High welding speeds + Only minor additional oxidation in the joining zone
High flexibility regarding the possible material combinations	 + Joining of CFRPC-CFRPC/GFRPC-GFRPC + Joining of CFRPC-GFRPC + Joining of GFRPC-Metal + Joining of CFRPC-Metal

Test rigging

This project initially intends to systematically investigate influences of the textile parameters of the reinforcement fabric regarding the heating behavior of a CFRPC component. Subsequently, an ideal laminate structure for induction welding will be set up, ensuring the polymer can be melted locally in the joining zone at very high welding speeds, while the polymer on the surface of the laminate will not melt (Fig. 1).

Advantages of joining thermoplastic CFRPC using induction welding technique



Fig. 1: Optimization of the laminate structure regarding higher welding speeds after heating-up tests of several reinforcement fabrics

Furthermore, a novel cooling device for the laminate surface shall be developed in order to attain a further increase of the joining speed. Simultaneously, a process simulation based on the Finite-Element-Method will be set up, which enables a prediction of suitable key parameter sets and provides a better insight of the process. Finally, based on the results of the investigations, the continuous induction welding process of CFRPC with maximum welding speed shall be verified with the induction welding head of IVW (Fig. 2).

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Fig. 2: Induction welding head for continuous induction welding of CFRPC (developed by Pfaff Industriesysteme und Maschinen).

The project "Process Optimization of Induction Welding of Continuous Carbon-Fiber Reinforced Thermoplastics by Process Simulation" is supported by Deutsche Forschungsgemeinschaft (DFG, MI 647/27-1).

EVER LIGHTER, EVER HARDER

Diamond coated tools work highly demanding special materials

The materials employed in the aerospace, automotive and medical industries present toolmakers with increasingly demanding requirements. What's more, there are challenging processes such as micromachining in which tools with a diameter of 0.03 to 1 millimetre process components with dimensions in the 1 mm to 1 cm range. Matched tools and application-specific surface solutions such as the Balinit Diamond family of coatings from Oerlikon Balzers can not only meet these challenges, but can also minimize costs.

Machining carbon-fibre composites (CFRP), aluminium alloys and other materials such as highly abrasive, non-ferrous metals, graphite and ceramics poses ever-new challenges for manufacturers of aircraft and automobile components as well as in the area of medical technology. This includes precision drill diameters to comply with the tightest tolerances in the aerospace industry, tool lifetimes that are as long as possible for economical and competitive machining processes as well as biocompatible coatings for efficient machining of ceramics in the world of medical technology, both for green-body and sintered ceramics.



The Balinit Diamond coating is adapted to the machining and tool type.

Tailor-made

Just as significant as the cutter material and the tool design are the surface and edge treatment, the interface engineering and an optimal tool coating. Oerlikon Balzers announces their new Balinit Diamond coatings to "open up a new dimension in terms of the variety of carbide types, higher coating thicknesses and increased reliability during machining: Their design is focused on the special requirements connected with machining CFRP, GFRP, sandwich materials, graphite, aluminium alloys and ceramics". Oerlikon Balzers offers tailored interface engineering for these demanding applications. "Our new Advanced Interface Engineering ensures even better coating adhesion. It is oriented towards use with a great number of carbides and we are able to match the coating to the customer's individual application with absolute perfection," explains Marco Schuite, Global Business Development Manager Diamond at Oerlikon Balzers.

Moreover, the coating variant which is optimal for the application (nanocrystalline or microcrystalline) is defined along with the ideal coating thickness. Standard options are 6, 8 or 12 microns. "The issue is



The best conditions must be created for high-performance cutting tools.



Balinit diamond nano for machining composite materials in the aerospace industry.

optimizing the performance of the respective combination of workpiece, tool and application", Schuite points out.

Hard as diamond

Deposited by means of the CVD process (Chemical Vapour Deposition), the Balinit Diamond coatings attain a hardness of up to 100 HIT GPa. "That makes our coatings as hard as diamond – the hardest material in the world," explains Marco Schuite. Balinit Diamond coatings thus ensure the highest wear resistance for all applications, can be employed at working temperatures of up to 600 degrees Celsius and improve the performance of cutting tools significantly.

Processing CFRP / composite materials

Composite materials are employed especially in the automotive and aerospace industries. For example, the new Airbus A350 uses a significant number of carbon fibre reinforced plastics (CFRP) components in order to save weight. However: These composite materials promote abrasive wear. Reliable and economical machining of glass fibre and carbon fibre reinforced plastics (GFRP, CFRP) becomes possible using tools coated with Balinit Diamond Nano. Its nanocrystalline structure provides exceptionally smooth coating properties and an excellent coefficient of friction.

Furthermore, this surface solution allows expensive and geometrically limited PCD tools to be replaced with significantly more economical, coated carbide tools. Advanced Interface Engineering and selection of the ideal coating thickness prevent burring and delamination, facilitate the chip flow and prevent the formation of built-up edges. Thus, abrasive and adhesive wear are significantly reduced. Longer service life and better surface quality minimize production costs markedly.

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VERY BIG IN SMALL

Newly developed micro cutting tools also for CFRP-/ GRP applications

HPTec GmbH located in Baden-Wuerttemberg produces micro cutting tools in the nominal diameter range of 0.05 – 7.00 mm. For the processing of CFRP and GRP materials HPTec has now developed its new tools – MCT (Micro Cutting Tools).

HPTec has been developing competence in the field of micro tools for the printed circuit board industry for more than 40 years in a determined and user-oriented manner. Proudly, the company based in Ravensburg nearby Lake of Constance refers to be the market leader in Europe in this area.

Multi-purpose fit

The market outside the printed circuit board has become more and more important for several years. HPTec strongly extended the segment of Micro Cutting Tools (MCT) accordingly. It includes the diameter range from 0.20 to 6.00 mm; specially adapted tool geometry ensures an efficient processing. The processing of CFRP/GRP materials as well as plastics, aluminum, copper/brass, graphite and high performance materials for the dental sector is possible with and without cooling system. HPTec offers the roughing and finishing tools with and without coating. Customers have several advantages:

- clean and burr-free cutting edges
- routing and drilling without delamination
- · minimal bond of chips at tool and com-
- ponent (improved chip transportation)high lifetime
- trimming in only one operation
- highest process stability in the mass production

Precision with tradition

Since the beginning of this year, HPTec is a member of the Carbon Composites e.V. (CCeV) and was also exhibiting at the Experience Composites in September in order to present the newly developed products.

HPTec has more than 40 years' experience in the processing of CFRP and GRP materials and therefore offers innovative geometry, lowest production tolerances and an overall quality check during the entire production process.



HPTec presented its new product lines e.g. at the Experience Composites

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ELABORATELY INTERWOVEN

German-japanese cooperation promotes new multi filament winding machine

Fibre-reinforced plastics (FRP) are well known for their high weight-related characteristics. This potential leads to an increase in the use of FRP in many industries. However, for a full market penetration and to make FRP suitable for series production, economic and efficient manufacturing processes are needed – as are implemented in the new multi filament winding machine MFW-48.

The multi filament winding technique offers high potential to meet these aforementioned requirements. Murata Machinery Ltd., Japan, is introducing a new multi filament winding technology to the market.



Multi-tasking

The new technology uses a large number of fibres simultaneously. The Multi Filament Winding machine MFW-48 for example has the capability to process 48 fibres. It offers the potential to produce preforms 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 laid down on the mandrel successively. These tubular parts are characterized 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 Concept of MFW-48

economic efficiency and increases productivity of preforming process.

Bilateral cooperation

Textile technology producer Murata and the Institut für Textiltechnik der RWTH Aachen (ITA), one of the biggest textile institutes in Germany, started a collaboration to establish MFW as innovative and economic production technology for composite structures in the European market.

To evaluate technical characteristics of the MFW composites the machine MFW-48 will be installed at ITA in the last quarter of 2016. With this step, new ways and opportunities for prototyping and analysis of the technology for various applications are opened up for German and European companies.

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CARBON COMPOSITES MAGAZIN

Redaktionsschluss für das nächste Carbon Composites Magazin ist der 13. Januar 2017.

Übrigens: Das Jahresthema 2017 beschäftigt sich mit Design.

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PERVASIVE ACTION

Nondestructive inspection of complex components and assemblies

Ultrasonic inspection of components and assemblies made of carbon fiber reinforced polymer (CFRP) is subject to special challenges due to material properties and complex component geometries. In order to optimize these inspections the simulation models which are used to adapt the ultrasonic inspections to relevant application parameters have to be modified and optimized accordingly. Saarbrücken based Fraunhofer Institute for Nondestructive Testing IZFP did just that.



In case of CFRP components with varying wall thicknesses, the ultrasonic signals which are already attenuated in CFRP materials, are further weakened. The mentioned signal damping is caused by different physical effects. A crucial factor of influence is the so-called anisotropy which means the directionality of certain material properties. Anisotropy affects sound signals to spread out along non-symmetric material directions, thus losing energy. Additionally, the ultrasonic signals are attenuated by the carbon fibers and the special behavior of the epoxy resin matrix.

Besides far-field approximations, the socalled Generalized Point Source Synthesis (GPSS), supplemented by approximation models, proved to be an efficient procedure to simulate ultrasound inspections in near- and far-fields.

Surround stereo - or better

A major challenge in practical ultrasound inspection is the choice of the appropriate insonification angle. Here, simulations can save a lot of time and efforts compared to experimental trial and error. Necessary modeling steps are related to the probeand wedge-dependent calculation of the sound field impinging onto the backwall, to the calculation of the wavefield reflected from the backwall by appropriate approximation models, and to the calculation of the backwall signal received in impulse/echo mode.

Especially in case of phased array applications the calculation of the delay times depending on the fiber orientation is needed to compensate the influence of the directional sound velocities. Then, even inhomogeneous fiber orientations can be handled by appropriate simulations.

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INDUSTRIES & CROSS SECTION

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Photo: Evop

BASIC HARMONIZATION

Expert task force advances standardization for automotive components' material

Active companies commit experts to contribute to the task force "Continuous Fiber Reinforced Thermoplastics in the Automotive Industry" formed in 2015. Together they are pushing a transparent and effective standard qualification plan for continuous fiber reinforced thermoplastics.

Material properties of continuous fiber reinforced thermoplastics are identified by experimental investigations often based on standards. Those standards are valid for different materials and often leave some room for interpretation in details. Sometimes several varying standards exist. For many conditions no national/international standards can be found or standards are not suitable because they were originally developed for e.g. thermoset materials.

material comparability application characterization effective & accurate reproducible, consistent, easy access transparent standards advanced material data procedure quality control quality control e Material users Testing Material supplie

Key Points

Against this background the task force's main goal is a transparent and effective standard qualification plan for continuous fiber reinforced thermoplastics (tapes and organic sheets). The focus within this qualification plan is on the four key points material characterization, comparability, application and quality control. The support of material users with more detailed and meaningful data for simulation will also be very important.

This expert task force was initiated under the umbrella of AVK by the following companies: Arkema, BASF, Covestro, Dupont, Evonik, Lanxess/Bond Laminates, Sabic, Tencate. IVW was selected by these companies to lead the task force, assemble the scientific questions and find solutions for a transparent and effective standardization. The results are discussed very closely with an OEM committee (BMW, Daimler, Ford, Opel, VW).

Progress

Since the founding of this expert task force one year ago the national and international state of standardization and different standardization plans were collected. A system of material properties and parameters was established and sorted in order of priority. Currently the team works on efficient and Task force objectives

robust characterization techniques for material parameters of the highest priority. The results are presented and discussed at conferences (e.g. AVK, CCeV).

Further information:

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Members of expert task force



DELIGHTED TO BE AT WORK

TRANSPORTATION

CCeV member takes first place in the employer rankings

csi entwicklungstechnik GmbH has taken first place in the latest kununu employer rankings in the automobile sector in Germany. Staff, apprentices and applicants have awarded csi a total of 4.49 from a possible 5 points and therefore evaluated them as the top employer.

CCeV member csi is a proven development partner for car manufacturers and system suppliers. The development of vehicles demands a lot of creativity and this is why the csi management lay so much emphasis on space for independent, self-responsible working methods and innovative ideas from their employees. Contributing factors are flexible work times, attractive events and a variety of further education possibilities.

Thumbs up

The proof that these measures are effective is demonstrated by the economic success of the company, which was founded in 1995 and currently employs over 550 people in eight locations around Germany. The kununu employer ranking explicity expresses furthermore, that no other company in the automotive industry could boast the positive employee evaluations that csi received in 2016.

The points achieved in the working atmosphere section (4.68) are a particular highlight. "Fun and enjoyment at work are the top priority here" was one of the anonymous comments contained in the evaluation. Managers are described as friendly and collegial, the tasks are described as varied and diversified and the fluctuation rate has been consistently low for many years. "We are thrilled about the positive votes from our employees" says csi founder and managing associate Steffen Boll. "It shows us that our corporate culture and our methods when it comes to employee and team development are on the right track."

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BEST INNOVATIONS

CCeV member receives award from automobile manufacturer

With the Supplier Innovation Award 2016 the BMW Group marked out Hufschmied Zerspanungstechnik. Worth the award were its systematic research of suitable milling technology, consultancy and customer service for the process optimisation in i3 and i8, concluding for the time being in a large number of contributions for the large-scale production of the carbon-core chassis of the BMW 7 series.

The Swabian producer Hufschmied Zerspanungssysteme GmbH was awarded the Supplier Innovation Award 2016 by the BMW Group, ranking second in the Production section.



For good reason

Hufschmied Zerspanungssysteme has developed and tested completely new milling tools and has optimised them for flawless processing routines. Fibre projections, delamination and chipping had to be eliminated reliably, in order to comply with quality requirements of the BMW Group.

At the point of commencement of large-scale series production, the Engineering department of the company provided strategic and processing advice. It was instrumental for the device layout and construction and contributed to the optimisation of both milling spindles and tool tapers to achieve a strong clamping layout. Proposals for the internal cooling of tools, dust extraction and handling of waste also contributed to the improvement of processing solutions.



Hufschmied is among the eighteen companies out of 3200 the BMW Group bestowed its fourth BMW Supplier Innovation Award on outstanding achievements in innovation and development and second in category "productivity"

Hufschmied Zerspanungssysteme GmbH is a manufacturer with many years of experience, commanding an extensive range of milling cutters and drills for tool making, mould construction and model making. The company is supplying customers in a variety of sectors worldwide.

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LIGHT WEIGHT DESIGN IN SPORTS CAR

TRANSPORTATION

Advanced Multimaterial Technologies applied in body in white win Innovation Award

Carbon fibre, aluminium and magnesium – the AMG GT R, the new spearhead of the sports car and performance brand Mercedes-AMG, employs an especially smart material mix. In recognition of its intelligent combination of high-tech materials, the AMG GT R has now won the Innovation Award at Experience Composites 2016, a new trade fair for fibre composite materials, lightweight design and carbon fibre.

While the chassis and body of the Mercedes AMG GT R utilise a variety of aluminium alloys, the boot lid made of steel and the front deck of magnesium. For the wheel catch struts, the lightweight design experts at AMG opted for a glas fiber material making them around 50 percent lighter than their steel counterparts. However, unlike carbon fibre, the steel versions are deformable.

Weighing just 13.9 kilograms, the carbon-fibre torque tube is 40 percent lighter than the already weight-optimised aluminium component in the AMG GT. In addition, a newly designed lightweight carbon-fibre tunnel cross replaces three other aluminium components in the GT. This structural element has not only enabled weight reduction, but has also significantly increased torsional stiffness by 7.5 percent.

Innovation Award

Tobias Moers, CEO of Mercedes-AMG GmbH, on the award: "We have systematically geared the entire structure of the new AMG GT R for performance using our expertise in composite materials."

Implementing carbon fibre, a light yet very strong material from the field of motorsports, has been essential to achieving these challenging goals. Carbon fibre is used as a material for such components as the front wings, the fender, the roof and the carbonfire torque tube for an exceptionally torsionally stiff connection between engine and transmission.

The high strength and torsional stiffness of the entire structure allows the transmission to withstand the extreme longitudinal and transverse forces from the powertrain and chassis. This reduces undesired elasticities enabling the vehicle to respond pre-



cisely and directly. In recognition of this intelligent combination of high-tech materials, the AMG GT R has now won the Innovation Award at the Experience Composites 2016, the new trade fair for fibre composite materials, lightweight design and carbon fibre.

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Awards show: The Innovation Award in the category "Automotive and Transport" is accepted by Dr. Karl-Heinz Füller (Manager Hybrid Materials, Concepts, AMG, Daimler AG), Fabio Utzeri (Component design CFK/ CFRP, Daimler AG), and Ralf Bernhardt (Manager Composites Development, Carcass, Mercedes-AMG GmbH) (f.l.t.r.)

DRIVING SPREE

Fiber reinforced composite structures in the Next-Generation-Car – Interurban Vehicle (NGC-IUV)

The German Aerospace Center (DLR) is developing innovative, functional-integrated, safe and light automotive vehicle structures within the DLR Next-Generation-Car (NGC) project. Various lightweight strategies are being studied on three different vehicle concepts in order to reduce the mass-related driving resistance and to improve the driving dynamics and passenger safety.

As a comfortable car for long distances, the "Interurban Vehicle" is the representative of the premium class segment within the NGC family.



Body in white of the NGC Interurban-Vehicle



Integrated optical fiber sensors

Sustained yields ...

In order to ensure the long required range of the emission-free fuel cell drive, the vehicle masses need to be reduced as much as possible. The structure of the vehicle, which is more than 5 meters long, therefore relies heavily on high-performance Fiber Reinforced Plastics (CFRP). For passenger protection and to protect the hydrogen storage tank located in the central vehicle floor, a crash concept with an intrusion-resistant passenger compartment and defined deformation and energy absorption zones in the vehicle's lateral areas is essential.



Floor module with hydrogen tanks



Mechanical test and simulation of CFRP structure

... with digital assistance

Due to the complex failure behavior of CFRP structures, precise predictions using explicit FE analyses in crash scenarios are very challenging. In order to improve the understanding of the material behavior, necessary for the design of crash structures, investigations are carried out on a generic component level. Mechanical relations within the inner structure can be studied for example with optical fiber sensor systems based on Fiber Bragg Grating (FBG).

A strong coupling of FE-calculations and test measurements can help to reduce the difference between simulations and tests. During loading it is possible to capture large numbers of strain measurements along the optical fiber. The obtained quantity of strain measurements is higher than with ordinary strain gauges, but, unlike with optical methods like digital image correlation (DIC), very accurate information can be obtained from the inner structure. Furthermore there is a possible use-case for such structurally integrated sensor systems in components for series applications. The condition of the component could be monitored during driving operation along its lifetime and help the early detection of structural damage.

Further information:

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Simplicity with composites: Electric buses featuring the new lightweight concept operating in Budapest city center

LIGHT TRAVEL

TRANSPORTATION

Self-supporting composite structure for public service buses

With a combination of Long Fiber Injection (LFI) process from KraussMaffei and InMold primer the Nanotechnology Center of Composites (NCC), the Russian lightweight construction research center in Moscow, produced a tailgate module in a self-supporting composite structure for a public service bus. This modular bus concept won the 2016 JEC Innovation Award.

MWT-110

In addition to low weight and corrosion resistance, the advantage with this production line is that the body blocks can be individually combined to produce vehicles which can be modulated. Production is therefore possible in large series for different utilization purposes. A compelling approach which not only impressed the jury for this year's JEC Innovation Award, but also the Budapest Bus Company. Electric buses with this concept have been operated in Budapest since March 2016.

Ready to paint

One important feature of this public service bus is the very large two-tone tailgate. It is 2.2 meters wide and 1.4 meters high. NCC relies on the system competence of KraussMaffei in this case. "The customer's requirements were clearly defined. The customer asked for a substantial weight reduction and Class A surface quality together with a rigid, high-strength component. A quick color change and, thus, a wide range of colors were also requested. All of this had to be achieved in short cycle times and with cost-optimized production," says Wolfgang Hinz, Product and Sales Manager in the Composites/Surfaces Business Unit and the responsible Project Manager at KraussMaffei.

A joint decision was taken with the customer to use a combination of the Long Fiber Injection (LFI) process and the InMold primer process. This has one advantage: the surfaces prepared perfectly for individual painting are produced directly and fully automatically in the mold. The cycle times can therefore be minimized, and first-class surfaces from high gloss to matt and a wide range of colors are possible.

As you like it

The LFI system has been successfully used in production since delivery in 2015. In terms of component weight, Hinz points out, the

LFI process scores with a low density of up to 55 percent. Other advantages of the LFI process are the high fiber volume content of up to 50 percent, which ensures high strength, and the high degree of flexibility in choosing fiber lengths. This permits a wide range of component designs, for example of ribs or function integration.

In the last step compression molding takes place without material flow and there is a reaction in the closed mold. The finished components are then removed and are now ready immediately for additional clear coating or final individual coating with no intermediate treatment or additional pretreatment necessary.

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SCIENCE FRICTION

CERAMIC COMPOSITES

Fabrication, evaluation and design of high performance C-fiber reinforced ceramic friction materials

The University of Bayreuth employs a very special test bench for C-fiber reinforced ceramic materials: On a nationwide unique dynamometer, large brake discs with a diameter up to 1 m can be studied at speeds up to 2500 rpm in combination with different counterparts, e.g. conventional or ceramic brake pads. Since the completion of this test rig several research projects were successfully realized.

C-fiber reinforced SiC (C/SiC) ceramics derives from aerospace applications, like heat protection systems. In the 1990s, researchers from the German Aerospace Center thought about new approaches regarding to this light weight (~ 2 g/cm³), damage tolerant and hard material. They studied the wear behavior in order to develop a new friction material, which is suitable for brake discs in passenger cars. Finally, they succeeded and today, more than 150,000 brakes are manufactured by the industry.

Ever more demanding

Due to the challenges of the current century, the demand of lightweight and high temperature stable materials rises steadily. In order, to fulfill these requirements in terms of ceramic friction materials, in 2009, a tribological test rig was designed at the University of Bayreuth. On this nationwide unique dynamometer, large brake discs with a diameter up to 1 m can be studied at speeds up to 2500 rpm in combination with different counterparts, e.g. conventional or ceramic brake pads.

In order to improve the dynamometer, fly wheels were added in the end of 2015 (Fig. 1). Now, inertia moments of about 150 kgm² are possible and the maximum braking force was increased to 50 kN per pad.



Fig. 1: Self designed dynamometer for high performance friction studies (with a steel fly wheel and a 1 m ø steel brake disc)

Stop brakes can be realized to simulate a braking event, e.g. from v_{max} = 150 km/h to 0 km/h with an inertia mass of a 1000 kg car.

Furthermore, tests at constant speeds are possible as well.

Findings proof success

During the last years, many experiences for emergency and services brakes were obtained, with C/SiC, organic and metallic materials. C/SiC ceramics show low wear and suitable coefficient of friction, even for high loads above 50 MPa and could act as a small, high loaded material for holding and emergency brakes in the future, e.g. for e-cars (Fig. 2).



Fig. 2: Surface topography of wear resistant C/SiC material after a stop brake from 20 m/s with 50 MPa braking pressure (left); state of the art material at the same conditions fails (right)

Finally, by applying CAD, braking materials can be transferred into models of the desired friction components for the industry. Calculations of the expected loads and tensions were already used to optimize the design of friction pads for brakes (Fig. 3).

Therefore, the University of Bayreuth can offer suitable material research and development, tribological investigations close to the desired application and the design of the new components for the end-users.





Fig. 3: FE-model of a brake disc (ø 380 mm) and brake pad calculated by FEM-software z88® (above); shear stresses after braking in a ceramic brake pad (~ 150x80x10 mm³) (below)

Further information:

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Ceramic heater

TEXTILE FOLLOWS FORM

CERAMIC COMPOSITES

New class of carbon fiber preforms for ceramic matrix composites

Coordinated by Hof University of Applied Sciences seven companies from textile and ceramic industry and four research institutes are developing innovative carbon fiber preforms for ceramic matrix composites (CMC) within the BMBF research project "CaGeFa".

CMCs are well known for their application as friction linings and insulation material in the aerospace and automotive industry. The preforms for the composites are conventionally built up by stacking and laminating woven fabrics and non-crimp-fabrics (NCF) or by CFRP-forming using short cut and staple fibers. As a result, the process steps for the production of CMCs are expensive, time-consuming and thus limiting a wider application.

Improvement wanted

In view of the low commercial availability, it is the goal of the current BMBF research project "Highly drapable carbon-NCF-fiberpreforms for efficient ceramic matrix composites – CaGeFa" to develop carbon preforms with a defined z-reinforcement to improve the material performance of CMCs (e. g. interlaminar shear strength, thermal conductivity, etc.) and to reduce process times and costs. In line with the project, the focus of the research activities is set along the entire process chain of the fabrication of fiber-reinforced ceramics – from textile semifinished products and preforming up to coating, ceramization and testing.

Innovation encouraged

Textiles developed for the preforms are special NCFs, radial woven fabrics, as well as carded, chopped and endless fiber nonwovens, which are processed in different combinations to achieve the respective requirements. Aside from PAN-based carbon fibers, pitch-based fibers are used as well, because they feature an improved thermal conductivity by comparison, though accompanied by a very high brittleness. By the subsequent preform needling of the semi-finished textiles a defined z-reinforcement is achieved through reorientation of the fibers, so that the required properties of structural density, interlaminar shear strength and impregnation behavior can be specifically adjusted. This requires a special layer selection in terms of fiber orientation and density as well as an adapted definition of needling parameters.



Variation of the sandwich preforms density according to requirements from 0.28 to 0.61 g/ cm³; NCF – non crimp fabric; CV – chopped fiber nonwoven; KV – carded nonwoven; DV – carded nonwoven as top layer; 100/65/50/30 – penetration density

Application tested

Accompanying processing, the qualification of the materials is carried out by textile and ceramic test procedures as well as by the non-destructive method of computed tomography (CT). The collected data includes information such as internal structure, fiber orientation, porosity and fiber length to provide the basis for a simulation program and consequently for a successful component design. In conjunction with the ceramization results, the aim is to derive a cause-effect-relationship between textile and fiber-reinforced ceramics in order to ensure a defined adaption of textile preforms for the application in CMCs.



Further information: **Dipl.-Ing. (FH) Alexandra Luft, Prof. Dr. Frank Ficker,** Hof University of Applied Sciences, Institute for Materials Science, phone +49 (0) 92 81 / 409-86 15, alexandra.luft@hof-university.de, www.hof-university.de/ifm Sandwich-Preform build up by stacking non-crimp-fabric and chopped fiber nonwoven



The research project "Highly drapable carbon-NCF-fiber-preforms for efficient ceramic matrix composites – CaGeFa" (reference number O3XO143A) is sponsored by the Federal Ministry of Education and Research (BMBF).



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CONGRESS IN CONSTRUCTION

CONSTRUCTION

8th Tudalit User Conference and 8th Architecture Prize

The 8th meeting of the Tudalit e.V. which took place this year in September at the Experience Composites fair in Augsburg was very well attended with over 130 participants. With exhibitions and a high-caliber symposium, Tudalit e.V. sent a clear signal as for the importance of the construction sector at this new high-tech fair.



The symposium, which attracts not only the members of Tudalit e.V. since the association's existence, has once again scored with a varied mix of hands-on reports and future-oriented research topics. The 30 contributions in six blocks were concentrated and discussed.

Helping hand

During the two-day conference the newly developed manual "Planermappe" was introduced. The association developed this publication as a guide for planning architects and engineers, for execution companies and for builders. The information given reflect the state of knowledge for the present general building approval (ABZ) "Reinforcement of reinforced concrete with Tudalit (textilereinforced concrete)". In the first section of the Planermappe, special features for construction companies are explained.

"The present ABZ is to be understood as initial development and entry-level technology. It is the result of a multi-year, up-to-date joint work of Tudalit members", said Ulrich Assmann from TUDAG, during the presentation (in German). The portfolio can be ordered as a ring binder at Tudalit e.V. or is available for downloading at www.tudalit. de/planermappe.

Young awardees

Also for the eighth time, the Architecture Prize was awarded to the students and graduates (from 2013 to 2016) of the fields of architecture, civil engineering, design, garden and landscape architecture.

The winners this year are two students from Berlin: Jakob Grave (TU Berlin, Institut für Massivbau) and Saqib Aziz (University of the Arts, Berlin) as well as a team of the University of Innsbruck (Institute for Experimental Architecture, Building Construction and Materials Science) with Mehmet Koc, Anna Pompermaier, Julian Rudigier and Christoph Schlopschnat. The prize – conjoined with 2.500 Euros each – was presented by the jury member architect Werner Sobek, Stuttgart, and Prof. Dr.-Ing. Peter Offermann as chairman of Tudalit e.V.

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Werner Sobek and Peter Offermann (centre) compliment Jakob Grave (l.) and Christoph Schlopschnat (r.)



FOOTBRIDGE TO THE FUTURE

CONSTRUCTION

New footbridge across Lake Lugano proofs prime example for lightweight design and construction

In the Swiss canton of Ticino, two towns now connect our present with the future: the new footbridge across Lake Lugano between Bissone and Melide is truly a sight to behold. The futuristic project was initiated by a team of visionary people led by an institute of the Department of Innovative Technologies at the University of Applied Sciences and Arts of Southern Switzerland (SUPSI). The construction of this pedestrian bridge is expected to be finished by the end of 2017.

The 18-metre long bridge features an ultralight skeletal structure modelled on the symmetry of a microorganism and looks like a spaceship gangway from the classic Stanley Kubrick film 'A Space Odyssey'. From further away, the bridge is reminiscent of a circular helix.



Airy design is a key feature of this stunning bridge project

One of a kind

The man connected to this bridge is Adriano Nasciuti, Head of the Mechanical Engineering and Materials Technology Institute at SUPSI. For years he and his team have been developing polimeric materials and ceramic foams, as well as designing and constructing composite building materials. The finished bridge is made from ultralight carbon fibre reinforced polymers (CFRP).

"The footbridge is currently the largest project of its kind worldwide," says Nasciuti proudly. "We are able to develop it this way thanks to the properties of the materials, which also explains the special design," he adds.

Light heavyweight

The incredibly high roof construction ensures the necessary stability required to make the most of the material properties. The entire bridge weighs just 1,200 kilos or 70 kilos per metre. "Its modularity is another advantage," continues Nasciuti. The bridge consists of twelve separate modular parts, each of which was vacuum cast using epoxy-resin. The pilot project was made possible with the support of the Swiss Federal Commission for Technology and Innovation (CTI) and the Canton of Ticino. And who knows, maybe it won't be long before there are also lightweight bridges for cars, lorries or trains that can be relocated easily if required.

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Architecture firm: Blue Office Architecture of Architect Filippo Broggini, Bellinzona Project planning partner: Ernst Basler & Partner, Zurich Manufacturing: Base Srl., Alserio (Como) Commissioned by: Canton of Ticino

DUE RESPECT

Dresden Carbon Concrete – researchers nominated for the German Future Prize 2016

Nominated for the German Future Prize 2016 are the Dresden professors Manfred Curbach, Director of the Institute of Massive Construction of the University of Technology Dresden, Chokri Cherif, Director of the Institute for Textile Machinery and High Performance Material Technology as well as Peter Offermann, chairman of the association Tudalit and member of the advisory board of the German Centre for Textile Concrete.

The nomination credits for the research and development of the new compound building material Carbon Concrete and its significance for the future of building.

Since the 1990s the Dresden professors have been working on the development of Carbon Concrete. The fundamental findings are based on the research concerning Textile Concrete in two special research areas of the German research association in Dresden and Aachen between 1999 and 2011. The findings obtained during this work were put into practice step-by-step. The foundation of the German Centre for Textile Concrete, the Tudalit e.V., the Tudatex GmbH as well as the CarboCon GmbH are the result of this intensive work. Different companies along the complete process chaine - from the raw material to the ready made building component - implement the results and the research has been continued since 2014 by Germany's largest research project for building: "C³ – Carbon Concrete Composite". Consortium leader is the Institute for Massive Construction of the TU Dresden under the leadership of Prof. Manfred Curbach. The C³-project is funded by the Federal Mi-



Nominated for German Future Prize 2016: Prof. Peter Offermann, Prof. Manfred Curbach, Prof. Chokri Cherif (f.l.t.r.)

nistry of Education and Reserach with up to 45 Mio. Euro. More than 140 companies forward the research on Carbon Concrete and cooperate on the successful introduction of the material into the market.

The German Future Prize of the Federal President is among the most important science awards in Germany. The nomination, the selection for the best, is already an honour. The Federal President awards single persons or groups making marketable outstanding technical, engineering or scientific innovations. In total three teams are nominated for the German Future Prize. German Federal President Joachim Gauck will award the winners on the 30th of November in Berlin.

Further information: www.deutscher-zukunftspreis.de

SHOW HOW IT'S DONE

What is Carbon Concrete and what can it be used for? How is it applied in practice, how is it installed? On 22nd September 2016 participants of an expert conference in Bremen were given the chance to examine and experience that. Dr. Frank Schladitz gave a talk during a joint event of the Official Materials Test Institute (Amtliche Materialprüfungsanstalt) of the Free Hanseatic City of Bremen (short MPA) and the Compost Association of the concrete building factories Bremen-Lower Saxony e.V. on the largest building research project of Germany, the C³-Carbon Concrete Composite. The topic of the talk was: "Textile Concrete as an alternative in concrete corrective maintenance". The C³-partners Pagel Spezial-Beton GmbH & Co. KG and the Torkret GmbH demonstrated the reinforcement of a reinforced concrete slab with Carbon Concrete.



Presentation of the processing of Carbon Concrete

TOUCH-AND-GO

Practical degree course as a personal career springboard

Bachelor degree instead of career end. In keeping with this goal, Eckert School's degree course "Fast Track" was created – especially for university dropouts. After a pre-study internship, the training as state-certified technologist is warranted, which is an important factor to the companies of the CCeV as well as to their contributors.

Up to this point study dropout had a negative effect on the curriculum vitae – but Fast Track offers a new opportunity to succeed.

2 degrees in 2.5 years

The training as industrial technologist parallel to state-certified technician is combined with work experience in a suitable partner company. After 2.5 years, both a bachelor degree and practical knowledge can be verified. Anyhow, during the selection of job applicants, numerous companies prefer such expertise. Thomas Skowronek, manager of the Eckert Schools, knows this very well: "Fast Track graduates are not Engineers who have never been inside a production hall. They were trained in the company and know what counts most – theoretically and practically."

A study put into practice

30 ECTS from previously acquired study qualifications will be credited. A first step towards closing the gap in the German education system. The path from university to a higher occupational career was hardly considered yet. "In times of over-academization and shortage of specialists, the role of higher vocational education is rapidly growing", tells Skowronek. "A university education is no longer the only way to obtain qualification and promotion prospects."

This holds true for Fast Track participants: after one year on the campus in Regenstauf, you are given the title of a state-certified industrial technologist. Afterwards, the second phase of the practical training begins: 1.5 years as specialist workers in partner companies until you complete the further education as a state-certified technician. Moreover, the acquired knowledge of the previous study was not in vain – participants put their theoretical knowledge in practical use. To summarize, an initial dropout soon will be replaced by a degree at Bachelor level and a great deal of practical know-how.

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Always worthwhile - closing the gap between theory and practical experience



RUN 'N' ROLL

ENERGY

Filament winding plant for the manufacture of rotor blades

In close cooperation with its customer Enercon in Aurich, one of the technology leaders in the wind turbine sector, Roth Composite Machinery (formerly known as EHA Composite Machinery) from the Hessian town of Steffenberg developed Filament Winding Plants for the manufacture of fiber-reinforced plastics (FRP) rotor blade components for Enercon wind turbines.

An increasing number of wind turbines are being installed in low-wind regions (onshore). For this application, plants with large rotor diameters are used, demanding special logistic requirements.

Roth Composite Machinery could get involved owing to its experience of more than 50 years in the manufacture of Filament Winding Plants (e.g. large-scale FRP containers or in the aerospace industry) with suitable know-how for the new technology with regard to the production of rotor blades.

The newly established manufacturing method enables the production of the rotor blades in segments so that they can be transported on overland routes with a small degree of efforts. Due to the design of the blades and the high rate of pre-assembly in the factory, a quick on-site installation is possible.

Layer structure

The machine applies glass fibre fabrics being impregnated by epoxy resin alternately with glass rovings. In the areas of the flanges, local thickness increase is reached by mounting. In this technologically advanced manufacturing process, Roth combines its three core businesses filament winding, winding technology as well as impregnation.

Machine concept

Structure of the winding machine:

- drive stand for initiating the torque
- flexible tailstock for the fixture of different mandrel lengths
- tool: 3D-mandrel
- movable platforms for the impregnating process and the material application



Roving impregnating station

When manufacturing products of this size, carrying the glass fibre material on a movable platform enables a nearly continuous material flow. The person operating the machine can optimally observe and control the process. Furthermore, material can be refilled without loss of time. With a rail length of almost 50 meters, components with diameters of approximately three meters and a length of about 20 meters can be produced. Final stages of product processing include the polymerization oven as well as demoulding.

Know-how and advisory service

As general contractor, Roth has the knowhow for the conception of complete production processes from the filament winding technology to the demoulding. This includes recommendations for the material selection – for example the kind of fibre – as well as the detailed analysis and solutions with regard to refinement in the production process. Thereby, the product determines the manufacturing procedure.

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Observing and controlling the winding process

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Roth Composite Machinery – Filament Winding & Prepreg

is an internationally operating system supplier in the mechanical engineering sector providing individual solutions for redesigning and optimizing your production processes. Our highly productive machine technology including patented features is accelerating your production to highest material efficiency. With over 50 years of experience and more than 500 machines sold worldwide, Roth Composite Machinery is the global technology leader. Besides the most distinguished university institutes, the leading manufacturers of the aerospace industries, the wind energy sector, the electrical engineering and particularly the successful mass-production manufacturers of pressure vessels benefit from our reliable systems.

Please ask our experts for giving advice.



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NOT SO FINAL FRONTIERS

Model-based processing of high-quality structural FRPC components in aerospace industries

Fibre-reinforced polymer composites (FRPC) are increasingly gaining importance in aerospace applications. Especially due to economic aspects out-of-autoclave processes are of high interest. FRPC feature excellent mechanical properties but are also outstanding as the actual material is defined through the manufacturing process. As a result, the management of the manufacturing process is of extraordinary importance.

Lead by the Austrian Montanuniversität Leoben, the project MoVeTech aims at implementing the concept of model-based processing for manufacturing of high-quality composite components through Advanced Resin Transfer Moulding (ARTM), a particularly promising member of the liquid composite moulding (LCM) techniques.

Model-based processing

This concept is based on the idea of actively incorporating phenomenologically based know-how about the driving mechanisms of a specific processing technique on the level of process management. This novel approach for process management will be proven in manufacturing a center hinge fitting (CHF), a structural aerospace FRPCcomponent acting as load application element in aerospace spoilers.

Project consortium

The project consortium working on the publicly funded project since 2015 is composed of Montanuniversität Leoben as leading organization involving the Chair in Processing of Composites and the Chair for Automation, as well as the company partners FACC Operations GmbH, internationally recognized for



Center hinge fitting for Airbus A330/340

developing and manufacturing FRPC components and systems for aerospace applications, Alpex Technologies GmbH, worldwide active in design and manufacturing of high-precision tooling, moulding and assembly solutions for aerospace and automotive industries and Langzauner GmbH, manufacturer of hydraulic presses with a specific focus on composite components. Further information: **Dr. Ewald Fauster,** Assistant Professor, Department Polymer Engineering and Science, Chair in Processing of Composites, Montanuniversität Leoben, phone +43 (O) 38 42 / 402-27 08, ewald.fauster@unileoben.ac.at, www.kunststofftechnik.at

The project is financially supported by the Austrian Ministry for Transport, Innovation and Technology within the frame of the FTI-initiative "Take Off", administered by the Austrian Research Promotion Agency (FFG).

VIRTUAL WORLD

Manufacturing process simulation for autoclave tooling optimization

The design of autoclave molds is even today mainly based on the experience of the tooling designer. After the mold has been produced and tested the options for possibly required optimization are significantly reduced compared to those that could have been done during an early design phase. Thus the Tooling Evolution & Improvement Team of Airbus Helicopters Deutschland GmbH introduces manufacturing process simulation (MPS) into the tooling design process.

If an autoclave mold cannot provide the desired part quality. Costly tooling re-work, higher rejection rates, or a delay in serial production are possible consequences, since mold testing and optimization cannot be carried out before the mold is actually produced.



Early action

The Tooling Evolution & Improvement Team of Airbus Helicopters Deutschland GmbH is aiming at overcoming those adversities by introducing manufacturing process simulation (MPS) into the tooling design process (Fig. 1). This MPS mainly aims at providing an estimation of the manufacturing outcome for different mold designs and at showing the influence of the mold on the parts' quality. Areas of principal interest are heat-up and curing characteristics, final part thickness, and fiber volume fraction as well as out-of-plane fiber wrinkling caused by the compaction of the material during autoclave processing.

The simulation applied is a sequential thermo-mechanical finite element analysis that predicts changes in resin properties during cure as well as tool-part-interaction, mismatch in coefficients of thermal expansion, resin flow during compaction, and interlaminar friction. User defined material models for ABAQUS[™] were developed and verified to provide adequate accuracy. The primary advantage of this simulation methodology is the focus on tool-part-interaction and interlaminar friction providing the capability to fully predict the molds' influence on part quality.

Taking maths on board

The use of MPS replaces the design from experience with a design based on the understanding of the physical phenomena and the evaluation of different tooling concepts by means of simulation. Although there is still



a need for more effort towards up-scaling for industrial application, the first thermal simulations nevertheless show the large potential of MPS for tooling optimization. Even for complex molds the simulation is capable of providing adequate accuracy and it enables fast parameter studies and sensitivity analysis (Fig. 2).

By means of the MPS different mold concepts can be evaluated within the virtual design phase leading to an optimized tooling design that requires only minimal testing and re-work and therefore provides a much faster and less cost-intensive entry into serial production.

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Fig. 2: H145 Fenestron™ shroud tooling thermal simulation: Comparison of the thermal simulation developed by Airbus Helicopters Deutschland GmbH with experimental measurement of the temperature distribution on the mold surface during a standard autoclave cycle.

TAILORED CARBON FIBRES

CROSS SECTION

Scientists of the Research Center Carbon Fibers Saxony at TU Dresden start their work

Carbon fibres play an increasing role in numerous industrial sectors like the automotive and aerospace industry, in civil engineering, in the medical technology, and in sports. Thus, the Institute of Lightweight Engineering and Polymer Technology (ILK) and the Institute of Textile Machinery and High Performance Material Technology (ITM) of the TU Dresden established the Research Center Carbon Fibers Saxony (RCCF) in April 2016. Now research there has started.

In spite of promising prospects, the potential of carbon fibres is not fully exploited yet since the understanding of the complex mechanisms of the structure formation during the fibre manufacturing process is still relatively low. The scientists at the newly founded RCCF in Dresden analyse the process-structure-property-relations within the carbon fibre manufacturing process across all relevant length scales. For this purpose, they use a cutting-edge manufacturing technology. The key components of the modular flexible carbon fibre production line are a solvent wet spinning device, a bicomponent melt spinning machine and a stabilisation and carbonisation line. The RCCF carbon fibre manufacturing line is designed to develop the process to tailor high performance carbon fibres based on established and novel precursor materials.

How to do it

Currently, the common technology to manufacture precursor fibres is the so called solvent wet spinning technology. The established precursor material polyacrylonitrile (PAN) is used at the RCCF. The solvent wet spinning device is designed in a modular and flexible manner in order to achieve highest precursor fibre qualities. Tailored multi-filament fibres can be spun with suitable spinnerets using storage tanks of 3 l or 70 l, throughputs between 0.3 l/h and 3.0 l/h and filament velocities up to 100 m/min.

Alternatively, the melt spinning technology is focused at the RCCF using a bicomponent melt spinning machine which is designed in a modular way in order to extend the technology towards dry spinning as well as monofilament spinning. A single screw extruder and a twin screw extruder with a maximum temperature up to 450 °C are available to spin thermoplastic filaments.



Close watch - scientist at work at the new Research Center Carbon Fibers Saxony

The stabilisation is the first step of the thermomechanical conversion of the precursor fibre to a carbon fibre. This procedure is the most time-consuming process step of the carbon fibre manufacturing. The conversion takes place in the stabilisation and carbonisation line of the RCCF at temperatures between 220 °C and 300 °C in four different temperature zones. The fibres pass those temperature zones up to seven times and are drawn depending on the temperature zone in order to specifically influence the inner fibre structure.

The carbon fibre structure which is formed during the stabilisation process is continuously modified in the subsequent carbonisation step. This process takes place under inert gas atmosphere (<20 ppm) in a low temperature furnace with 450 °C to 1050 °C and a high temperature furnace with 1050 °C to 1500 °C. Four individual temperature zones can be triggered within both furnaces. Finally, matrix-adapted sizes are applied to the fibres in the following sizing process.

Carbon fibres with custom-fitted properties for different applications can be manufactured in the RCCF carbon fibre line on a la-



Fibres are set to defined tensions for the sizing process.

boratory scale. Those fundamental scientific findings can be directly transferred into industrial applications together with industrial partners in the future.

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Dr. rer. nat. Martin Kirsten,

Research Group Leader, Institute of Textile Machinery and High Performance Material Technology (ITM), TU Dresden, phone +49 (O) 351/ 20 25 01 75, martin.kirsten@tu-dresden.de, www.tu-dresden.de/mw/itm Mineral based basalt fibers score with lightness, high mechanical strength, corrosion and chemical resistance, with high friction, frost, heat and moisture resistance, UV-lightfastness, sound and vibration absorption, anti-fouling and their dielectric character

V FOR VERSATILE AND VIABLE

CROSS SECTION

1000

Basalt fibers - ready to enter high performance industries?

Increasing development efforts and publicity on the volcanic basalt fiber arouse interest of Airbus Helicopters regarding application potential in aeronautics. Subsequently a screening was carried out – here come the findings.

Suppliers state that the properties of the filament may expand the profile of currently used reinforcements in composites.

Statements, ...

With mechanical properties similar to S-2 glass, the price range lies between E and S-2 glass fibers. Furthermore, the excellent thermal and chemical durability as well as abrasion resistance are highlighted. Environmental aspects are addressed by the use of an abundant natural raw material, low energy consumption during manufacturing and possibilities for recycling. The profile is completed by high thermal/electrical insulation and acoustic damping properties.

... challenges ...

Besides beneficial economical and material properties, an additional requirement for aeronautical materials is reproducible high quality with low scatter within and between material batches. Airbus Helicopters is currently investigating these aspects in the frame of a screening of off-the-shelf basalt fibers.

In fact, basalt fiber is produced in a melt spinning process which is similar to glass fiber production. Yet some additional challenges emerge. The use of a natural raw material with high thermal insulation may cause thermal and chemical inhomogeneity during the melt spinning process. Another focus is on the interaction between basalt fiber, applied sizing and common aerospace resins.

... and disparities

A wide spectrum of qualities was found during the screening including individual strengths and weaknesses of each supplier. Nevertheless, some products can compete with the reference S-2 glass fibers. It is therefore a logical move that the industry is on a quest for applications where the individual characteristics of their product match perfectly. For this task, valuable support comes from the BasaltFaserNetzwerk (www.bafanet.com). A prominent use case is to replace steel rebars in the building industry by a more lightweight and corrosionfree basalt reinforcement.

In order to accelerate the improvement progress, high performance applications shall be targeted as soon as possible. Mechanically uncritical structures such as interior parts and linings in the aeronautical and automotive industry can be appropriate. The lessons learnt, an increased and continuous production will enable the manufacturers to work on the remaining quality aspects and to offer a high performance product.

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KEEPING TRACK

CROSS SECTION

Smart software system for efficient Technology Data Management (TDM)

Located in Dresden, Saxony, the Symate GmbH develops and commercializes the browser-based software-platform Detact® for the integrated management of technology data. Detact is made for the special requirements of engineers in research institutes and manufacturing companies who want to digitalize, analyze and visualize complex technical processes to create process transparency and to expand their engineering knowledge.

The software uses data produced permanently in test series and/or manufacturing processes, for instance in machines, electronic controls or various databases. The potential of this knowledge resource has been little used to date because of the difficulties in handling and synchronizing such big amounts of data manually. With its high level of automation, online-capability and data integration, Detact reduces the effort to understand and to develop complex technologies – the engineer gets the right information at the right time at the touch of a button.

Gladly outsourced

Especially in the field of lightweight construction engineers are faced with the challenge to manage the complexity of developing new materials, like fiber-reinforced composites, or innovative manufacturing processes. For example, an essential part of their work is the experimental investigation of material characteristics. With the complexity of materials increases the analysis and test effort, as well as the amount of data. Up to 30 percent of the total effort is caused by data handling activities; e.g. to bring together experimental data from different testing machines and software systems. By automating data collection, integration and analysis, the software Detact significantly reduces non-productive data management activities. Thus, engineers can work more focused and efficient.

Practical examples

The Leichtbau Zentrum Sachsen GmbH (LZS) has successfully applied Detact since 2014. The director of LZS, Dr. Ulf Martin, emphasizes: "For us, Detact is an important tool to optimize our internal research and development processes. Furthermore, through the use of the software we are building up specialized knowledge of the collection and analysis of system parameters. It is intended to make this expertise available for our customers and development partners, as an addition to our services for the users of fiber-reinforced composite technologies."

Yet the devlopment project between Carbon Concrete Composite (C³) and Symate

shows, that data management is not confined to one single company alone. C³ is the largest national research project in civil engineering in Germany and pushes forward the practical application of carbon concrete. Over 140 project partners from science, economy and associations at different locations must be organized efficiently. Symate networks the C³ project partner with Detact, thus making the knowledge transfer much easier. Development processes are accelerated and traceable by achieving online-access to experimental data across different institutes and locations, e.g. to prevent duplication of testing.

Summarizing these two example projects, Detact creates the prerequisites for mastering the increasing complexity of modern manufacturing technologies through a particularly highly automated data utilization.

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