List of Poster-Abstracts

K1 Alternative spreading methods as key for thin-ply composites
Appel, Lars, (Lars.Appel@ita.rwth-aachen); Happach, Wilko, Gries, Thomas

Abstract
Carbon fiber-reinforced plastic (CFRP) with very low single layer area weight (less than 80 g/m², so-called thin-ply composites) represent the next step in composite development. They increase the mechanical properties compared to standard CFRP. In particular, the tensile strength, fatigue strength and breaking strength can be improved. [1, 2] These improvements make it possible to manufacture CFRP components with lower weight and longer service life, thereby reducing the associated costs and CO2 emissions. The bottleneck in the production of thin-ply composites is the spreading process. The standard bar spreading process can only achieve an area weight of approx. 80 g/m². In order to achieve single layer area weight with less than 80 g/m², alternative spreading methods are required. Therefore, alternative spreading methods for the production of thin-ply composites are presented and evaluated.

K2 Modular machine set-up for the production of splitted carbon fiber rovings
Vonberg, Klaus (Klaus.Vonberg@ita.rwth-aachen); Gries, Thomas

Abstract
The price for fine carbon fiber tows is high compared with heavy tows. Moreover, there is a demand for textiles and composites made from these textiles especially for visible surfaces. The new machine “SSM Carbon” features a modular design and it is suitable for spreading, splitting and winding of carbon fibers. This procedure reduces the costs significantly for fine tows. Additionally, a tailor-made number of single filaments can be produced. The spread and split carbon fibers can be processed e. g. by twisting or hybridization with glass fibers or thermoplastic filament yarns. The machine setup comprises the following elements that can be integrated depending upon the customer’s requirements: Spreading unit, splitting unit (adjustable number of filaments between 3 K and 12 K) and a winding unit. Carbon fiber rovings can be processed and other fibers are possible. In this poster presentation the machine approach will be presented.
K3 Polyethylene Based Carbon Fiber Production: Cost Analysis
Röding, Tim (Tim.Roeding@ita.rwth-aachen.de); De Palmenaer, Andreas; Gries, Thomas

Abstract
Today’s carbon fiber market is dominated by carbon fibers based on polyacrylonitrile (PAN), which account for more than 96% of the market due to the quality of the fiber produced. PAN-based carbon fibers are characterized by impressive tensile strength and high production costs (15 – 20 €/kg). However, latest findings show that polyethylene (PE) based carbon fibers are the most promising alternative to achieve cost and properties targets of mass market applications. The poster presents the results of a detailed cost analysis of the production of PE based carbon fibers. The analysis focuses on determining the production costs and identifying the main cost drivers. Hence, the cost breakdown of both process routes (PE and PAN) is compared. The poster also gives an insight into the PE-based carbon fibers’ future.

K4 Development of ultra low-weight hollow carbon fibres
Pursche, Franz (Franz.Pursche@ita.rwth-aachen.de); Brüll, Robert; Langgartner, Janis; Gries, Thomas

Abstract
The main goal of this research work is the development of ultra-low weight hollow carbon fibres. These fibres can be produced quicker than standard carbon fibres and have a reduced weight with comparable mechanical properties. These effects result in a minimized CFRP weight and increase the total cost efficiency. This research shows the production process of hollow carbon fibres. The focus lies on the stabilization and carbonization process. For the stabilization and carbonization process parameters are developed, by which the hollow structure of the fibres is maintained. SEM microscopy is used to measure the change of surface properties during stabilization and carbonization. FTIR and DSC are used for further analytics of the stabilization process. The stabilization and carbonization process of the hollow carbon fibres is compared to the stabilization and carbonization of “conventional” carbon fibres. The final product is a carbonized fibre with a hollow cross section.

K5 Carbon fibre brushes for weld cleaning
Pohlkemper, Felix (Felix.Pohlkemper@ita.rwth-aachen.de); Pursche, Franz; Antoine, Philipp; Gries, Thomas

Abstract
Welds on stainless steel generally show noticeable irregularities in appearance and form after the welding process. Weld cleaning therefore plays a crucial role in metal processing. Nowadays pickling is the most common cleaning method. Nearly 65% of all produced raw steels are pickled at least once. During pickling, the component is dipped in a highly toxic pickle and washed afterwards. Toxic pickles pose a danger to humans and the environment. Therefore especially the disposal of used pickle and wastewater is complicated and causes high costs. In addition to the environmental impact, the long exposure time of more than 15 minutes is a limiting factor for the cycle time of welded components. This research work focuses on an alternative weld cleaning method: Electrochemical cleaning of welds with carbon fiber brushes. Main advantages are drastically reduced process times (< 1 min) and reduced burdens to human health and environment.
K6 Investigation on recycled carbon fibers for the identification of additives to increase the interfacial shear strength to the PA 6 matrix
Hunkemöller, Jonas (Jonas.Hunkemoeller@ita.rwth-aachen.de); Cloppenburg, Frederik; Lyapin, Andrey; Gries, Thomas

Abstract
The efficient recycling of carbon fiber composites is a current challenge to the automotive industry worldwide. Carbon Fibers that are thermal recovered from carbon fiber reinforced polymers are unsized. A process step for the resizing of the fibre is necessary in order to prevent a damaging of the fibres during the production of the non-woven fabric and to ensure adequate interfacial shear strength (IFSS).
An alternative is given by an ultrasonic based bonding of the chopped fibers. In this case the resizing process is not necessary, if the requirements for the IFSS are fulfilled. Therefore, investigations on the IFSS between unsized carbon fibers and PA6 and the influence of additives are performed in order to identify suitable additives. These investigations are focused on the tensile strength and elongation, the topology of the surface by scanning electron microscopy (REM) and the functional groups on the surface by X-ray photoelectron spectroscopy (XPS).

K7 Minimized stabilization time during carbon fibre production
Pursche, Franz; (Franz.Pursche@ita.rwth-aachen.de); Biche, Waldemar; Kellermann, Carolina; Gries, Thomas

Abstract
Because of their outstanding mechanical properties combined with low density carbon fibres are in the last years increasingly used for light-weight applications in the transport or the energy industry. However, due to their energy demanding production process carbon fibres are still not used for mass applications (e.g. automotive industry) because of their high price (15 – 25 €/kg). One bottleneck in the thermal conversion of polyacrylonitrile (PAN) based precursors to carbon fibres is the process step of stabilization. Stabilization requires temperatures up to 300 °C and process times up to 120 minutes. Nearly 50 % of total conversion costs are accounted by stabilization. The approach of this research work is the reduction of stabilization times in order to minimize the total production costs of carbon fibres. As a result, the total stabilization time is reduced to 20 minutes while maintaining the mechanical properties comparable to a Toho Tenax HTS40 carbon fibre.

K8 New production line for thermoplastic composites
Lücking, Alexander (Alexander.Luecking@ita.rwth-aachen.de); Haas, Richard; Brüll, Robert; Gries, Thomas

Abstract
The film stacking method is the industrial standard for the manufacturing of fibre reinforced thermoplastic composites (FRTCs). Commingling thermoplastic fibres with reinforcement fibres, e. g. glass fibres, is another option to produce hybrid yarns. However, the composites produced by the use of film-stacking or hybrid yarns cannot achieve high blending quality to get full impregnation of reinforcement fibres with the matrix polymer. The aim of the research is coating each single glass filament in the glass fibre nozzle drawing process to achieve a homogenous distribution of glass fibres and matrix in the final composite. The approach uses particles with a diameter from 2 up to 15 µm of Polyamide 12 (PA 12) which are electrostatically charged and blown at an E glass filament in the nozzle drawing process.
K9 Automated Laser Processing of Carbon Fiber Preforms
Oppitz, Sebastian (Sebastian.Oppitz@ita.rwth-aachen); Janssen, Stefan; Gries, Thomas

Abstract
Current state of the art lightweight strategies are using hybrid constructions of metal- and composite-materials, especially Fiber Reinforced Plastics (FRP). Economically and technically advantageous processes for the integration of fasteners in FRP provide the basis for the substitution of commercial parts by beneficial composite elements. Objectives of the research project “LaserInsert” are to increase required pull-out forces of fasteners for composites and to reduce the amount of process steps and time for an application of fasteners. The approach is the development of a beneficial process to integrate metal fasteners in textile preforms. The textile preforms are drilled by using ultra-short pulsed laser radiation. Laser drilling of CFRP-preforms offers the possibility to economically manufacture notches into the unconsolidated textile. The highly precise notches are used for fastener integration. Due to the innovative process chain, increased pull-out forces, less process steps and reduced process times can be realized.