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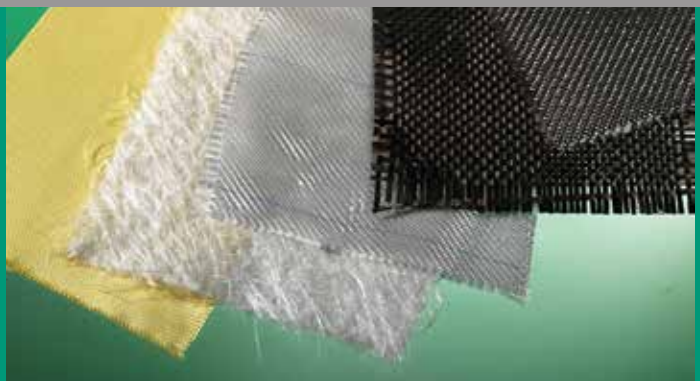
FRAUNHOFER-INSTITUT FÜR CHEMISCHE TECHNOLOGIE ICT



LEADING MEMBER IN ITD ECO DESIGN (ED)

FRAUNHOFER ICT-ACTIVITIES IN THE CLEAN SKY JTI

ITD eco DESIGN (ED)

The integrated technology demonstrator project (ITD) is devided in two parts: eco DESIGN Airframe (EDA) and eco DESIGN Systems (EDS).

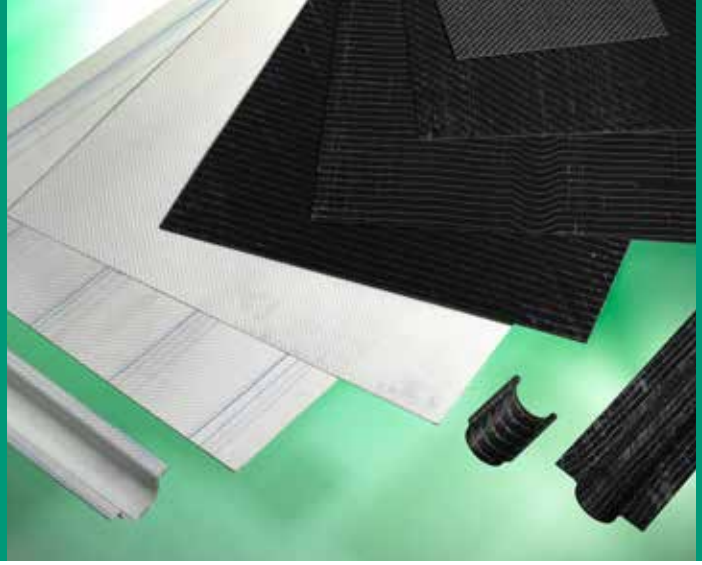
In eco DESIGN Airframe life cycle assessment (LCA) tools and a database tailored for the aeronautic industry will be developed. The tools address every aspect of the A/C lifecycle except fuel consumption. More than one hundred technologies will be investigated for application potential and reduced environmental impact and evaluated with the LCA tools. The results from the selection, processing and recycling of environmentally sound materials will be combined to generate an eco DESIGN Guideline, which will enable the implementation of a green product life cycle for the aeroplanes of the future.

The aims of Fraunhofer ICT in Clean Sky eco DESIGN are:

– to develop environmentally friendly composites with improved behaviour regarding environmental impacts and recyclability
– to develop new surface treatments with improved behaviour regarding corrosion, flammability, antimicrobial and self cleaning properties
– to extend the use of renewable resources in the aircraft industry
– to provide innovative and effective solutions for polymer flame retardants
– to develop new manufacturing technolgies and to improve current ones to de crease resource consumption and to reduce emissions
– to identify and to mature end-of-life options for aircraft dismantling and re-use

CLEANSKY

eco DESIGN



Manufacturing technologies

LFT-D technology is used to produce long-fibre-reinforced thermoplastics. This technology enables the production of tailor-made compounds reinforced by long glass fibres for immediate processing in a press. Flexible and adaptable to the production of relatively large components, systems will handle not only glass but also polymer-, carbon-, and natural fibres as well as recycled materials. The objective in eco DESIGN ITD is to adapt this process to innovative composite materials, for example those based on renewable resources.

High-performance composite components with continuous-fibre reinforcements based on textile structures made from glass, carbon and aramid fibres are applied increasingly in the aeronautic industry. In the frame of the ITD's "eco DESIGN" and "Green Regional Aircraft", at Fraunhofer ICT two different approaches are being pursued involving thermosetting and thermoplastic resin transfer moulding (RTM/T-RTM) technology:
RTM: Material and process development for microwave-assisted accelerated curing of thermosetting matrices.
T-RTM: Material, process and component development for in-situ polymerisation in one step together with the textile fibre reinforcing structures in the mould.

Another process to produce high-performance composites with a thermoplastic matrix is the in-situ injection process, which is an innovative process developed at Fraunhofer ICT. This process allows a high volume production of composites with high fibre volume using an injection moulding machine.

In the processing of polyurethane, the highly flexible fibre spray process is of particular interest. In combination with local reinforcement structures made from continuous fibres or metals, new application fields are being developed for polyurethane structural components with a multi-material design. Fraunhofer ICT carries out intensive research on polyols based on renewable resources, and on the fire retardancy as well as the recycling of such material systems.

Renewable resources

The use of natural sources for materials in technical applications is a key research field of Fraunhofer ICT. Sugar, starch, or lignin are used as building blocks to synthesise thermoplastic or thermoset resins. Polymer synthesis processes are available in lab and pilot scale, along with the appropriate analytics for chemical and mechanical characterisation of the products.

Flame retardants

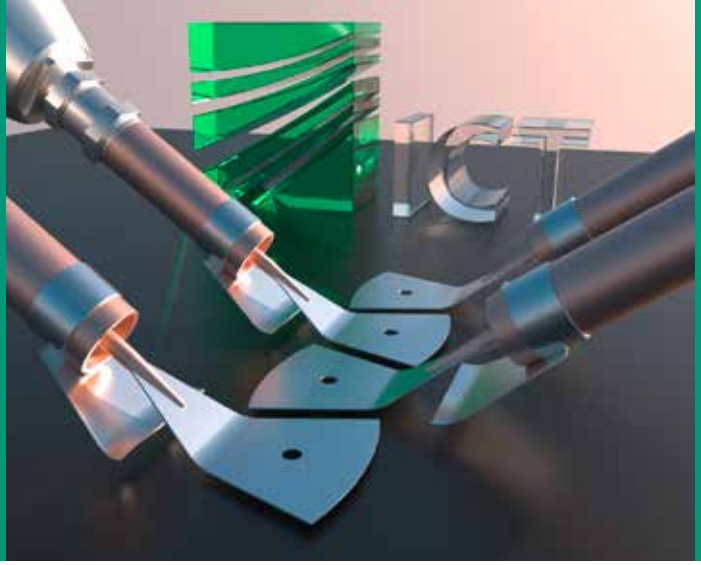
Substitution of halogen flame retardants using aluminium or phosphorous compounds has been under research for years, starting with reactive flame retardants in polyurethanes. These reactive components have been synthesised and tested at Fraunhofer ICT. For qualification, several standardised small-scale burner tests are available, along with flue gas characterisation.

Composites

Focusing on fibre-composite compression moulding, (reactive-)injection-moulding, microwave and plasma technologies, mould making and processing technologies and the development of new materials our activities cover nearly all major areas of modern plastic processing. In fibre-composite technologies Fraunhofer ICT is specialised in the processing of long- and continuous-fibre-reinforced thermoplastic and thermoset materials.

Recycling of carbon fibres from composites

The Fraunhofer ICT designed a microwave oven and developed the process to pyrolyse carbon-fibre-reinforced composites to recycle the carbon fibre. Because of the very short pyrolysis time of only a few minutes the carbon fibres are not damaged by the process. The polymer matrix was completely decomposed and the fibres could be removed. In the next step the pyrolysis gases will be used as precursors for new chemicals.



End-of-life options

Since more than a decade Fraunhofer ICT houses the center of excellence "LOOP", providing solutions both for production scrap and end-of-life products and materials. Once the reusable parts have been identified and dismantled from the aircraft, the remaining materials must be processed to generate the maximum added value. To this end, Fraunhofer ICT offers numerous in-house processes for the grinding, sieving and sorting of composite materials on a pilot scale. Moreover, pyrolysis and solvolysis processes are available to separate and to recover miscellaneous materials, along with the means for characterisation and analytics.

Simplified trailing edge

The technologies developed within eco DESIGN are demonstrated in several applications, including a trailing edge demonstrator. The design of the demonstrator will be based on the design of the aileron of the Do228. In particular, the end box of the aileron is used as a reference. The dimensions are 652 mm in span wise direction and 335 mm chord wise between the C-spar and the trailing edge. The materials used are CFRP and aluminium.

Fraunhofer's task within this demonstrator is the preform manufacturing of a component called C-Spar. The related technology used for preforming is the new and innovative "chemical stitching" preform fixation process. Chemical stitching was optimised within eco DESIGN for the preforming of continuous, dry, semi-finished carbon fibre products.

Green PU seating cushions

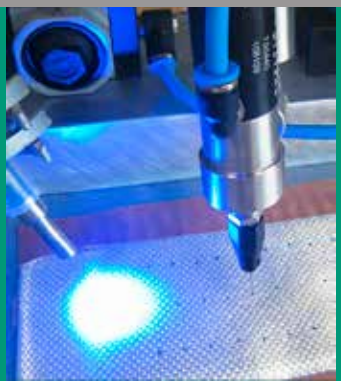
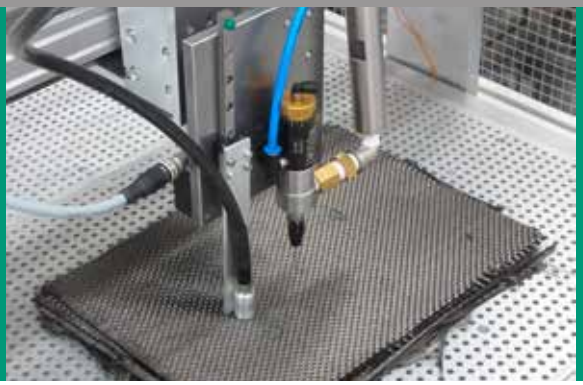
The use of renewable resources for materials in technical applications is a key research field in Fraunhofer. Together with Axyal (France) height resilient PU foams were developed for modern lightweight airliner seating. The foams were optimised to fulfill high environmental standards. Fifty percent of the PU polyol was substituted by green materials and a nontoxic, non-halogenated fire protection was established. The design of the seating cushions was based on hardness, comfort parameters and surface interface pressure.

eco DESIGN Guideline

The results from the research and development will be made available in an "eco DESIGN Guideline", which is intended to be the first comprehensive guideline for aircraft design, production, repair, and end-of-life steps from an environmental point of view and in an easy-to-use format. In addition, Fraunhofer ICT will contribute in numerous fields of technology development such as polymer processing, analytics, exhaust gas treatment, and production scrap recovery.

ITD Green regional aircraft (GRA)

The objective of the ITD is the development of an aircraft with a very low basic weight and reduced sound emission.
In this ITD GRA Fraunhofer ICT developed a new hybrid material based on carbon fibre composites with improved impact properties. The carbon fibre composites were produced from out-of-autoclave material using a vacuum compaction method and co-cured with a thermoplastic outer surface. The thermoplastic outer surface acts as an effective impact protection. The laminate was cured with a newly-developed microwave antenna system for direct heating of the carbon fibres. Generic parts were manufactured from the new hybrid material with the innovative curing method. The result was that the new hybrid material had better impact properties. About 60% of the impact energy was converted to elastic energy, without influencing other properties (weight, mechanical strength etc.).


FRAUNHOFER ICT – ABOUT US

The Fraunhofer ICT has around 500 employees. Approx. 16 000 m² of well-equipped laboratories, pilot plants and offices are available for work on research projects. Emphasis is placed on processing technology, design, characterisation and quality assessment of energetic materials and polymer products. This also includes their behaviour throughout their lifecycle, recycling and disposal as well as the design, set-up and operation of pilot plants.

Commercial research

In the commercial research sector, Fraunhofer ICT works mainly on plastics-related projects such as material development and selection, product development, component design and processing technology, especially in terms of the further development of direct processes. Recycling management and sustainable development define company strategies for future generations. The Fraunhofer ICT is one of the most high-profile research institutes in the environmental technology sector.

The field of environmental simulation has been decisively shaped by the Fraunhofer ICT, which investigates the effects of environmental influences on materials and technical products. For over 40 years the Institute has been the headquarters of the well-known German GUS Society for Environmental Engineering (Gesellschaft für Umweltsimulation e.V.).

Defense research

The Fraunhofer ICT is the only explosives research institute in Germany that offers a full spectrum from laboratory testing through technical processing to fully developed systems. It has many years of experience in the core competence of energetic materials, for example solid rocket propellants or high explosives, and has been a research partner of the German Defense Ministry for over 50 years. Important civil applications of energetic products are gas generators and airbag technology as well as solid-propellant rocket engines for space travel.

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