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Research area: Product aims

Paper, paperboard and board // technical specialty papers

Key words:

Lightweight-design, Semi-finished product, recycled fibers, carbon-composite, "organo-sheet"material

Title:
rCF-Hybid – Novel hybrid semi-finished materials based on recycled carbon fibers for use in structural lightweight design

Background/Problem area

It was shown in previous research projects (e.g. FullCycle) that the wet-laid process is an effective processing route for short cut carbon fibers, especially for recycled carbon fibers. Those fibers, especially if they result from pyrolysis are weaken and brittle after the high-temperature treatment and tend to shortening and dusting during further processing. As mixing of the fibers takes place in aqueous solution, hereby fiber shortening is decreased and dusting is minimized as long as there is residual moisture content. On the other hand, it was also seen that the mechanical performance of such nonwoven-reinforced composites is limited due to the limited fiber length that is processable in the wet-laid formation (max. 30mm). Hence, the approach of this project is, to combine rCF-nonwoven media with unidirectional fiber tapes (UD-Tapes based on virgin fibers). This combination enables a layer-wise design of the composite structure, using the UD-Tapes in layers with high expected loads and using the rCF-nonwoven e.g. as highly homogenous surface layer.

Objectives/Research results

Aim of the project is the development of a novel hybrid composite material consisting of recycled carbon fibers immobilized in nonwoven layers and UD-Tapes based on virgin carbon fibers. The thermoplastic matrix will be PA6 (fibers in case of the nonwoven, film/foil in case of the UD-Tape). The material shall be given as a thin thermoplastic prepreg which can be consolidated via heat pressing into 3-dimensional organo-sheet products.

The development of the wet-laid media has already started, hereby recycled carbon fibers from CarboNXT are used in different fiber length and mixtures thereof. A static heat press can be used to determine the optimum ratio of carbon and PA6 fibers for the consolidation step (homogeneous wetting of the carbon fibers with PA6) and mechanical parameters of the sheet material will be measured. Besides this the cetex institute is using virgin carbon fibers from Mitsubishi to develop the UD-Tapes. Afterwards the parameters for producing the multi-material composite needs to be investigated. Up-Scaling of the developments in pilot-scale is planned in 2018. Data collection as basis for the simulative calculations has started and will be continuous ongoing to provide representative parameters for the single materials as well as for the multi-material composite. And the end it should be possible to predict material performance as a function of number and type of the combined layers (e.g.”x” layers nonwoven in combination with “y” layers UD-Tape resulting in performance “z”).

Application/Economic benefits

Lightweight components are on the rise above all technical fields, e.g. vehicle and aircraft construction. Due to a more flexible manufacturing process and lower cycle times are in particular thermoplastic composites a constantly growing product group. The amount of CFRP (carbon-fiber-reinforced-plastics) waste from manufacturing and end-of-life components will drastically increase. Recycling processes based on pyrolysis are realized in industrial scale, but the bulk of resulting fiber fractions is <60mm in fiber length and therefore not interesting for many textile processing procedures. The wet-laid process is an appropriate route of transforming short recycled carbon fibers into a processable raw material – but combination with long-fiber materials is mandatory to obtain composite materials with competitive mechanical properties.

Period of time: 01.01.2017 – 30.06.2019

Remarks

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