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Research area: Product aims	**Key words:**
Paper, paperboard and board // Technical speciality papers	Drapability, semi-finished product, hydroentanglement, "organo-sheet"material

TITLE:

3-D-formable wet-laid media

Background/Problem area

During the previous IGF Project 401 ZN "Development of a wet-laid process for producing directional carbon fibre prepregs made of C-fibre recyclates for use in tool construction, among other fields" it was seen that the papermaking process is an effective processing route for short cut recycled carbon fibers. It was also seen that 3-D-formability of the wet-laid media (so-called drapability) was insufficient for use in 3-D-structural elements.

Drapability of fibrous media can be increased using longer, flexible (crimped) fibers, multi-layered structures and by using tailor-made binding resins. From textile media it is also known that drapability correlates to the float stitch of the textile. Based on this, it should be investigated if it is possible to improve drapability by influencing the number and position of fiber-fiber-binding points via Hydroentaglement of the wet-laid. The pilot paper machine was equipped with a spunlace-device directly on the forming board, were high-pressure water jet can be applied to the still wet media. Complementary to this recipe of the wet-laid media will be optimized concerning binding fibers, fiber length, fiber diameter and so one - overall aim is to achieve a drapable semi-finished product useful for structural components.

Objectives/Research results

There are two main development routes relating to the commonly used composite materials: Composites with duroplastic matrices (e.g. epoxy) and composites with thermoplastic matrices ("organo-sheet"material, e.g. with PA6-matrix). For both materials recipes will be developed in lab-scale, investigating the processing properties (impregnation and pressing behavior) of the media. Epoxy resins will be used to represent duroplastic matrices, fibrous polyamide 6 will be used representing the thermoplastic matrices.

Not more than two recipes per route will be used afterwards for upscaling trials on the pilot paper machine. There also will be started the first trials concerning hydroentanglement of the media. Variable parameters are: diameter of the jet nozzles, jet pressure and dwell. Influences on drapability will be measured by LCC via picture frame test and double sinus stamping test. It was agreed to work with basalt fibers representing reinforcing fibers in general, and to do confirmative trials at the end of the developments with glass fibers and carbon fibers.

Sheet recipes with various contents of Polyamide 6 acting as thermoplastic matrix were developed in lab-scale and tested concerning thermoforming behavior. Also up-scaling of the lab-recipes to the pilot-paper machine was done successfully. As expected strain values for the thermoplastic samples with PA6 are initially higher than for the duroplastic samples with 90% Basalt fibers. The bending behavior is dominated by the amount and the length of the reinforcing fibers. The duroplastic samples with the high basalt content were even too stiff to be measurable. Characterizations concerning the spunlaced samples are still ongoing.

Application/Economic benefits

Paper-based organic-sheet media will be the initial point of a lower-cost composite in existing applications as well as in new applications in which this material had been too expensive so far. As the papermaking process is flexible with regard to thickness of the media and mixing with thermoplastic components, it is likely possible to manufacture an organic-sheet-material in a one-step-process and to avoid an additional impregnation step. The papermaking process is inexpensive (4€/kg) compared to textile engineering (20€/kg) and also has a higher production rate. Furthermore, overall costs can be minimized using recycled reinforcing fibers instead of virgin fibers.

Period of time: 01.04.2015 – 31.03.2017

Remarks

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