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Research area: Product aims

Paper, paperboard and board // Technical specialty papers

Key words:

Moulded pulp structures, functional enhancement, functional fillers, retention, dewatering

TITLE:

Functional enhancement of moulded pulp structures by adapting process conditions for the high-grade incorporation of functional fillers

Background/Problem area

The pulp moulding process offers diverse possibilities for producing complex three-dimensional fibre-based moulded parts. This technology makes it possible, for instance, to realise asymmetrical shapes with a high height/diameter ratio of the moulded parts as well as multicavity shapes. The current applications of moulded pulp structures are found predominantly in the packaging field. The innate functionality of moulded pulp structures is their shock absorption properties by virtue of the pulp and constructive engineering. Functional enhancement with respect to the specific property fields such as an adsorption (e.g. pollutant adsorption) or flame-retardant function requires the high-grade incorporation of functional fillers. The forming process is of critical importance regarding the homogeneity of the material structure of the moulded pulp structure and a corresponding incorporation of the fillers. The dewatering of the pulp suspension – which is significantly influenced by the use of the fillers – plays a crucial role for the uniform layer structure.

Objectives/Research results

The objective of the research project is to adapt the process conditions in the pulp moulding process so that functional fillers are incorporated into the moulded pulp structures. A process concept is to be developed for the high-grade incorporation of functional particulate substances into moulded pulp structures that will make a homogeneous material structure of the moulded structure with the corresponding functional properties possible. In so doing, the functionalities focus on the adsorption and reduction in the fire load and the thermal stability of the moulded structure.

The dichotomy that exists between the incorporation of the functional fillers and the forming process is determined by the dewatering of the pulp suspension and its dewatering behaviour. The solution of this problem is on the one hand the specific adaptation of the pulp system in conjunction with process-related additives and, on the other hand, measures designed to improve dewatering during the forming process (e.g. temperature, ultrasound).

The studies within the framework of the work thus deal initially with the chemical-physical conditions during forming that are influenced by the fibre components, the filler components and the use of specific process-related additives. Relevant laboratory-scale trials have been conducted in terms of a material screening designed to characterise retention and dewatering behaviour. An evaluation system was developed to assess the many parameter settings investigated. Target and limit values were defined for the two criteria retention and dewatering in order to differentiate between test results. The evaluation system was used for assessing the DoE, making it possible to differentiate between the various formulations and identify promising stock systems with high functional filler content on the basis of the aforementioned criteria. Further, a test stand for the pilot-scale production of fibre-based moulded parts (custom product) was designed, built and put into operation. After several modifications and adjustments, the envisaged moulding tests could be successfully realised on the test stand.

Application/Economic benefits

The expansion of the functional properties of moulded pulp structures offers a wide variety of new or additional application possibilities for the use of fibre-based 3D moulded structures. SMEs from the manufacturing sector and from diverse application sectors can set up new product lines and open up a new customer base. Basically all sectors are worth considering in which compact 3D structures (with shapes that have many degrees of freedom of the structure) are used and relevant functional properties are required. As far as adsorption is concerned, there are a myriad of possible uses for the adsorption of odorous or harmful substances in the field of automotive engineering (passenger compartment), in the construction / furniture sector, in the field of presentation media or generally in the filtration field. In particular the focus is on fields of application in which filling is not possible, and structures with a compact shape provide corresponding advantages. Application possibilities for moulded pulp structures with a low fire load/high temperature resistance are found in the field of light-weight construction, thermal insulation (e.g. automotive engineering), in the field of friction materials or in the case of special packaging.

Project period: 01.08.2015 – 31.01.2018

Remarks

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