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Research area: Product aims

End products made of paper, paperboard and board // Other

Key words:

Mechanical properties of fibre based materials, optical strain field analysis, Poisson's ratio, shear modulus, material mechanics simulation, design of packaging and lightweight materials

TITLE:**Optical analysis of strain fields to determine mechanical properties of fibre-based materials****Background/Problem area**

An essential prerequisite for utilizing the potential of paperfibre-based materials in lightweight construction is the application of design principles that are already established in other areas, e.g. mechanical or construction engineering. For this purpose an improved material characterisation is required, since some of the needed parameters are not easily accessible or not available at all. The use of optical strain field measurements in principle is suitable for an enhanced analysis of material displacements due to mechanical loading and might overcome this problem. However, a further method development is needed for the determination of the associated material parameters.

Objectives/Research results

The project aims at the development of new methods to determine hitherto difficult to access material-mechanical parameters such as shear modulus and Poisson's ratio of thin natural fibre-based materials. For this purpose optical strain measurement systems are used, that offer a great potential for the detailed analysis of displacements and strains in mechanical loading experiments of fibre-based semi-finished or finished products. The information obtained from the evaluation of two-dimensional strain fields is used to derive individual material properties in the context of continuum mechanics formulations of material laws and to provide direct support to the design process of new or improved products.

The following sub goals are to be achieved:

- adaptation of appropriate test sites by extension of the existing equipment via the combination of mechanical loading with optical strain field measurements
- development of methods for direct and indirect determination of material parameters and screening the range of applications
- determination of mechanical material characteristics such as Poisson's ratio and shear modulus, associated elastic and plastic deformation boundaries for the use in continuum mechanics and associated material laws
- practice relevant recommendations for selected manufacturing processes and design steps concerning cardboard and corrugated board products

Application/Economic benefits

The economic importance of the project is to make attractive semi-finished products based on paper fibres to a broad range of other industries where they might substitute established materials based on oil or other fossil fuels. This enables new applications for cellulosic paper fibre materials, for example in customized three-dimensional packaging solutions and in construction or lightweight applications. Harnessing development and design methods from other areas for paperfibre-based materials opens up new markets for semi-finished composite materials at a marketable price level by means of established paper production technologies. A targeted and load-oriented design e.g. in the field of packaging papers will lead to innovative, lightweight and rigid packaging products. Economic benefits are a result of raw material savings and decreased transport costs due to basis weight reductions. These effects also make an active contribution to sustainability (energy efficiency, resource utilization).

Period of time: 01.07.2014 – 31.12.2016

Remarks

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