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Research area: Product aims

Paper, paperboard and board // Technical specialty papers

Key words:

Composite; paper; sheet; resin; light-weight construction

TITLE:

Development of a paper-sheet metal composite for a high-strength, thin-walled body panel in automotive engineering

Background/Problem area

The use of high-strength, thin-walled sheet metal in automotive engineering holds great potential for a significant savings of material as a result of mass reduction and thus higher energy efficiency. It has not yet been possible, however, to tap the full potential of the thin-walled body panels owing to their poor vibration behaviour and their poor sound deadening.

Initial preliminary studies showed that the acoustic behaviour of such panels can be improved significantly by applying a layer of paper to them. To be used in automotive engineering, however, such paper-sheet metal composites must meet a large number of requirements. In addition to guaranteeing the mechanical and acoustic properties, the composites must also ensure good workability and durability, for example.

Objectives/Research results

The objective of the project is to develop a multifunctional paper-sheet metal composite designed to improve the vibration behaviour and acoustic deadening of high-strength, thin-walled body panels for car body construction with a view to reducing the mass and saving energy in car manufacturing. Investigations started defining the requirements of the composite. They indicated that a glue layer, fibre-additive formulation, binder and impregnation should be developed in such a way that the composite shows strong viscoelastic properties and viscous internal frictional losses of particles as high as possible, thus significantly reducing its acoustic emission properties.

Considering the results for sound propagation and absorption, two-dimensional paperboards differing in their particular fibre composition as well as in the pre-treatment of the fibres and the area related mass were produced on a pilot scale at PTS. Furthermore, using the same fibre formulations, three-dimensional fibre bodies were developed in a pulp moulding process. At the same time, a binder especially optimised for the impregnation of the fibre samples was developed. Afterwards, trials on the impregnation behaviour and the stickiness of the two- and three-dimensional samples were carried out. Resin uptake, the influence of a pre-treatment with paraffin as well as mechanical properties were analysed. In addition, suitable sheet metal and shaping conditions were selected. Optimal performance characteristics for the deep drawing process were set with a view to producing a finished part that can be readily provided with an adhesive as well as an impregnated paper structure in the form of a stable and dimensionally accurate material sample.

Production of the entire composite of paper and sheet metal was begun based on this knowledge. Manufacturing processes for the entire composite were developed using the fibre-matrix systems that had been developed and the sheet metal that had been selected. It was possible to successfully combine the various binder-fibre material combinations to form sandwich structures consisting of two top plies of impregnated paper and a core structure of impregnated moulded pulp. In a second step, these structures were successfully glued to the sheet metal to form a paper-metal composite whose properties were subsequently examined.

In compliance with the normative recommended marginal conditions for test set-ups designed to examine the vibration damping of flat workpiece / semifinished product samples, a detailed, parameterised, numerical model was created in terms of the geometrical properties and material properties. Using this model, recommendations were then made for an enhanced composite structure. The entire composite is currently being optimised by modifying the individual components fibre body, binder / adhesive and sheet metal.

Application/Economic benefits

The material is to be designed in such a way that a wide variety of different sectors can benefit from it. The group of users includes companies in the following sectors:

- The sheet metal working industry, construction industry and mechanical engineering
- Automotive engineering (cars, railway technology, airplane, ship, container construction)
- Housings, switch cabinets for industry and home electronics as well as household appliance technology
- Manufacturers of fibres and adhesives, paper composites and additives.

The benefits derive from the use of mass-savings pieces of sheet metal by developing novel paper composites with multifunctional product properties. The novelty also includes the use of regenerative raw materials which will replace synthetic, petrochemically based man-made fibres. This in turn will enhance the environmental compatibility of the composite.

Period of time: 01.07.2010 - 31.10.2012

Remarks

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