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FRAUNHOFER INSTITUTE FOR MANUFACTURING TECHNOLOGY
AND ADVANCED MATERIALS IFAM, BRANCH LAB DRESDEN

1 *Sandwich element for light-weight construction*
2 *Hollow sphere structure for reinforcement in an automobile*

LIGHTWEIGHT CONSTRUCTION BY LOCAL REINFORCEMENT WITH HOLLOW SPHERE STRUCTURES

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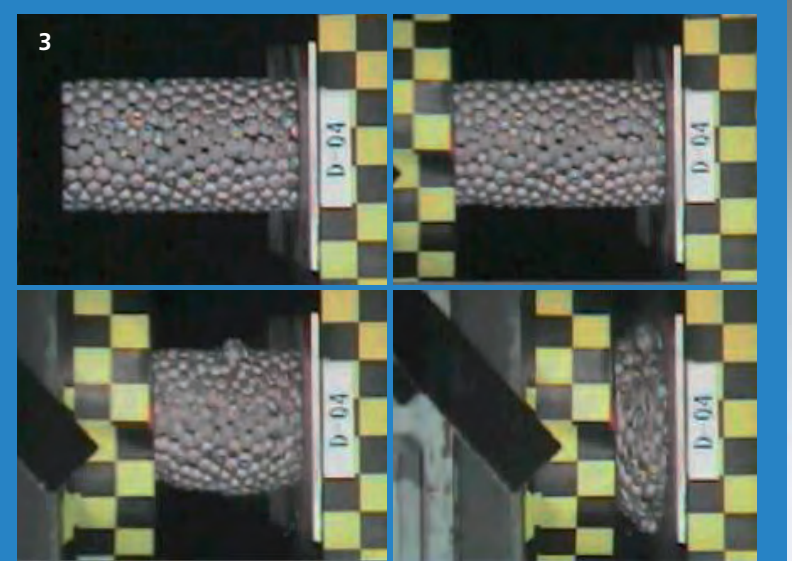
In order to allow for the increased requirements of modern lightweight concepts, a mixture of optimal materials at the right position is needed. At the same time, additional functions need to be integrated into the components. The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM in Dresden develops cellular metal materials which can be adjusted to various requirements as core materials in sandwich structures and profiles, and which can take over additional functions.

Considerable weight reduction of profiles and sandwiches is possible if the realization of local reinforcement allows for the reduction of wall thicknesses.

Such reinforcements by metal hollow sphere structures exhibit a locally enhanced strength and prevention from collapse of critical areas.

Due to the low densities of the hollow sphere structures in the range of 0.3 up to 0.8 g/cm³, the mass reduction of the lower wall thicknesses of the profiles exceeds the mass gain of the reinforcements in most of the cases. The reinforcement is realized by inserts or by filling with sintered and adhesion-coated single hollow spheres.

Picture 2 gives an example of how such a filling for the reinforcement of a B-pillar of an automobile may be integrated.



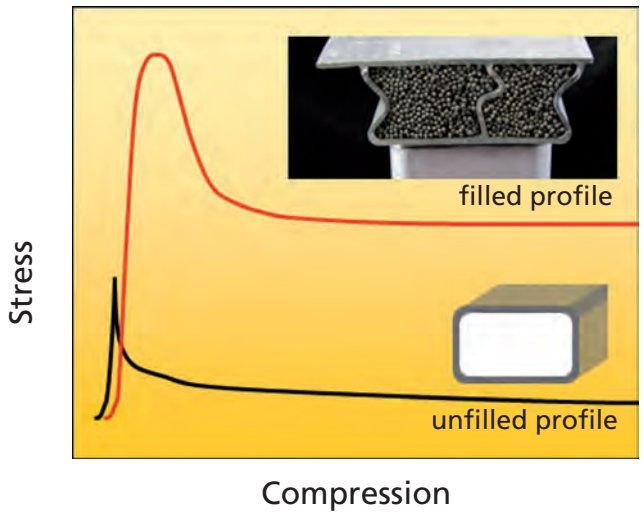
By adjusting the density and the basic material of the hollow sphere structure the needed mechanical, thermal and corrosive properties are tailored. Furthermore, by adjusting the kinetic energy absorption of the hollow sphere structure the required volume of the crash absorbers may be determined. The required volume of such parts may be lowered considerably in comparison to an unfilled absorber.

Hollow metal spheres can be filled with fine ceramic particles. Thus, the material achieves enormous damping capabilities at ultralow weight. As an example, at a density of 1.5 g/cm³ the damping factor of the new material exceeds the damping factor of aluminium by a factor of 100.

This enables the improvement of the absorption of structure-borne sound as well as the resonance frequencies of components. The powder metallurgical manufacturing technology being developed at Fraunhofer IFAM Dresden at present is being transferred to an industrial fabrication. Thus, the manufacturing of larger quantities will be possible in the near future.

R&D Services

- Application oriented studies of questions related to materials and manufacturing
- Materials evaluation with respect to strength, energy absorption, damping, corrosion resistance and application at higher temperatures.
- Technology development of
  - Loading-adapted cores in sandwich structures
  - High kinetic energy absorption (crash, high speed deformation)
  - Damping of structure-borne sound
  - Bonding technologies (sintering, soldering, adhesive bonding)
- Prototype and small series production
- Materials and component testing
  - Accredited testing lab (powder analysis, mechanical testing)
  - Damping analysis
  - Corrosion studies
  - High temperature characterization
- Know-how transfer for industrial production



Comparison of a profile filled with hollow sphere structures and an unfilled profile

1 *Snap shot of a crash test with hollow sphere structures in order to demonstrate the high energy absorption capability*

2 *Components filled with hollow sphere structures before and after crash test*