Research Institute:
PTS München
Heßstr. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:
Dr. F. Miletzky

Project leader:
Christoph Sorg
Tel: 089 / 12146-175
Fax: 089 / 12146-36
E-Mail: christoph.sorg@ptspaper.de

Research area: Product aims
Paper, paperboard and board // Technical specialty papers

Key words:
Ceramic, preceramic paper, Killn furniture

Title: Killn furnitures based on pre-ceramic papers

Background/Problem area

Ceramic lightweight structures made by classical ceramic shape forming processes (for example extrusion) are difficult to realize and very expensive. To reduce the thermal mass of ceramic components for using in high temperature applications and also the energy conservation linked with a lower thermal mass the ceramic industry is highly interested in cheap ceramic lightweight structures.

Supporting elements (killn furnitures) are necessary regarding technical and economic points of view of a thermal conversion process (sinter process) for the production of ceramic products. Killn furnitures allow a sealing of the burning articles or an economic utilisation of the oven space by stacking and supporting the ceramic goods. Partially large amounts of ceramic killn furnitures are necessary (up to the 8-times mass of the real ceramic goods). Ceramic lightweight supporting elements can lead to an intensive mass reduction which entails a reduction of the thermal conversion energy expenses and therefore also of the final product expenses.

Objectives/Research results

PTS and “Werkstoffzentrum Rheinbach GmbH (WZR)” intend to co-operate by the development of killn furnitures based on highly filled ceramic sinter papers. On account of the highly productive paper production, the adaptable plasticity of the medium "Paper" and the resultant of thin and porous ceramics and therefore clear prize advantages are to be expected.

The objective of this project is to use the pre-ceramic papers after sintering as killn furnitures based on corrugated cardboard structures. In cooperation with WZR pre-ceramic papers were developed and thermally converted into ceramic bodies which were tested mainly regarding their porosity, strength and thermal properties.

In the first part of the project, different types of pre-ceramic papers were produced in order to find out the correlations between the paper and the resulting porosities within the ceramic microstructure. In the work package “paper development” aluminium oxide powders were used as fillers in shares of 78 to 84 weight percent. Further short fibre systems with different fibre geometries were tested. The impact of densifying the papers by calendering was also one focus of the examinations in this work package.

The task of WZR is to find the optimum thermal conversion for each type of corrugated cardboard structures by testing different temperature-time profiles while sintering. Also the development of a pre-ceramic gluing system was part of the work package “paper converting”.

Results show ceramic properties like porosity range of 20 - 30 % with a resulting bending strength up to 160 MPa, which is typically for this porous ceramic elements. Properties depend on the used ceramic raw material and its average particle diameter. Several particle sizes were tested within the highly filled paper and burned into technical ceramics. Also the alternative material system “cordierite” was tested successful which shows also a general potential for using as killn furnitures. Both systems were scaled up to pilot paper machine level in several optimization loops. Paper derived ceramics produced at Werkstoffzentrum Rheinbach are called PT-Ceramic®.

Application/Economic benefits

The use of pre-ceramic papers as flexible green body before sintering combined with paper converting technologies promises new flat and filigree ceramic structures (for example corrugated cardboard structures). This new process should deliver a cost reduced way to achieve new market segments in high temperature applications. The focus herewith is the application of killn furnitures.

The research results will be used by German paper manufacturer and converting plants. Secondly, they will have an impact on the future trend of German SMEs (small or medium-sized enterprises) in the ceramic industry. Low cost applications of pre-ceramic based ceramic systems could evolve into a totally new market for German enterprises once the current technical problems such as porosity and thermal strength has been solved.

Period of time: 01.10.2008 – 30.09.2010

Remarks

The research project ZIM-KF 2037901WZ8 is being funded by the German Federal Ministry of Economics and Technology BMWi and is being performed together with Werkstoffzentrum Rheinbach GmbH.