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

Key words:
Cast metal, foundry, highly filled paper, high temperature, specialty paper

TITLE:

Paper derived metal casting systems

Background/Problem area

Large metal structures with complex geometries are typically produced by founding. In foundries large structures are realized by sand casting. The cavities for the castings are typically filled with liquid metal using ceramic tubes. These tubes are produced by an energy consuming sintering process, are heavy and difficult to handle. Moreover the regeneration of the casting sand is made more difficult due to heavy pieces of the used ceramic tubes. In the Japanese market recently pulp based tubes for casting systems were introduced. The tubes are fabricated by pulp molding and exhibit a huge content of inorganic fillers to show high temperature resistance. This tubes exhibit big advantages by means of handling and removal. However due to the production process the length of these tubes is limited and no gradient within the tube wall can be effectively realized to tailor the tube wall for the high temperature application.

Objectives/Research results

Objective of the project is the base development of paper derived metal casting systems (tubes) using a paper machine and the winding core process. For this purpose papers highly filled with inorganic fillers and inorganic binders with high temperature resistance are to be developed in lab and pilot plant scale. The papers are to be adapted to the core winding process. During the winding process a gradient within the tube wall is to be realized to tailor the tube wall for the high temperature application. Improvements in cost effectiveness and handling compared to conventional casting tubes are to be demonstrated.

In the first project phase the requirements for the use as metal casting system are defined and the selection of raw materials is performed. Based on the different inorganic filler systems highly filled papers were developed in laboratory scale. The paper variants varied in kind of filler, filler content and degree of densification. These paper sheets were characterized and used for paper stacks consisting of 4 paper layers. The layers were glued together using organic and inorganic binder systems. The multi layer paper stack simulated the multilayer structure of winding cores for first tests with liquid metal. In the frame of static and dynamic casting test the resistance of the different paper stacks to the liquid metal were tested. Based on the results the most promising filler/Binder systems were selected for further optimization loops. Based on the most promising paper and stack variants different kinds of tubes were produced in laboratory scale. The kind and composition of the binder systems was furthermore improved. These tubes were tested in the frame of static and dynamic casting tests. Based on the results specific filler/Binder-Systems were selected and scaled up to pilot plant scale. The resulting paper was used for the manufacture of further tubes for casting tests. In interative optimisation cycles the tubes were furthermore optimised concerning the paper composition, the structure and thickness of the tube wall and the kind and content of the binder system.

Application/Economic benefits

Highly filled papers as speciality papers are a new interesting product particularly for small and medium-sized enterprises (SME) in the area of paper production. SME are flexible enough to incorporate new speciality paper species in their product portfolio. In addition to that smaller production masses of highly filled papers as precursors for metal casting systems fit to their business model.

Based on the project results the potential of highly filled papers as precursor material for high temperature applications is derivable. Paper industry (paper production and paper converting) in cooperation with metal industry will be able to start specific product developments in the area of metal casting systems. Due to the advantages of paper derived metal casting systems the competitiveness of foundries, comprising a lot of small and medium sized enterprises in Germany, is improved.

Period of time: 01.07.2010 – 31.10.2012

Remarks

The research project IGF 16610 N is being funded by the German Federal Ministry of Economics and Technology BMWi and is being performed together with the Institute of Casting Technology in Düsseldorf.