Zukunft Bau

Paper panels based on recycled paper dust – Material and process development

The current project aims for the development of processes for products made of recycled paper fibre. The used paper dust comes up during the recycling process and complicates it. Therefore, the re-utilisation is a desirable aim to save resources and to minimize costs for waste disposal. Furthermore, fields of application for cellulose-containing products should be found.

Different source materials were chosen which act as main component for production of bind paper panels. The source materials consist of recycled paper fibre or paper dust (which comes up during the recycling process). They contain different flame inhibitors in various concentrations. Thus either the concentration of borate ranges from 0.4 % to 25 % or the source material contents ammonium polyphosphate and aluminium hydroxide. They have been tested in combination with binders, such as carboxymethyl cellulose (different viscosities), methyl cellulose, gluten, acryl binder, lignin, various pastes, and bone glue.
For the production process freeze gelation BegoSol K (with SiO_2-Nanoparticles) was used as a binder. In order to obtain additional characteristics, functional aggregates were mixed in, as fungicides and hydrophobing agents. In contrast to the functional aggregates, the source materials contain the flame inhibitors.
Four routes were developed for the production of paper panels. Throughout, first all dry substances have to be mixed and afterwards the fluid substances have to be added. The homogenous mixture was processed on different ways. On one hand, the mixture can be pelletised using an extruder. For the other three routes the mixture is filled in a mould and either dried by microwaves or in a kiln or frozen at -80 °C. Afterwards the paper panels are laid out for cooling or drying, respectively.
Many variable parameters of the production process (e.g. source material, production process, water content and leavening agent) were varied regarding special characteristics of the paper panels.
Further, thermal conductivity, sound absorption, fire behaviour, hydrophobing, mildew resistance, particle size distribution, and bending strength were examined.
Unfortunately all measured heat conductivities of the tested paper panels slightly exceed the target value for commercial isolation materials. Thus there is still some potential for the optimisation concerning the production route and choice of binder and source materials.
Good sound absorption results were obtained on paper panels produced by using microwaves for drying.
With the results of fire behaviour tests, a classification of fire class B2 (normally flammable according to DIN EN ISO 11925-2) is assumed.
Hydrophobing of paper panels is possible during the production process as well as after drying.

Furthermore, the results of mildew behaviour are very promising. Even with a very low content of borate, no mildew growth occurs. In the case of the absence of borate, mildew growth can be inhibited by means of adding chalk.
Qualitatively estimated, the pore size of paper panels ranges from lower micrometers to millimetres. This depends on the production route.
The bending strength of the produced samples is on the order of magnitude of commercial structural panels such as Pavaclay®.

Also possibilities for surface treatment (paint, plaster, laminate) were tested with sufficiently visual results. All mentioned treatments were easy to perform.
Beside the experimental part, strategies for technical arrangements and applicability of paper dust products were reviewed. Possible fields of application are for example thermal and acoustic isolation, or as displays.

Based on the results of this project the University of Bremen submitted the production process for patent to the German Patent and Trade Mark Office under the reference number 10 2012 015 539.5.

Process routes for the production of paper panels made of cellulose-containing source material were successfully developed.
Depending on production process and source material, different shapes can be realised. Further, the properties of the panels may be configured to open new fields of application.
Adjusting e.g. the porosity of paper panels, would open the possibility to develop panels with very interesting properties for the use for interior fitting which can be recycled as waste paper after their lifetime.
The bending strength is on the order of magnitude of commercial structural panels. Since the heat conductivity of tested panels is insufficient yet, further studies have to be performed.

Eckdaten

Kurztitel: Paper panels

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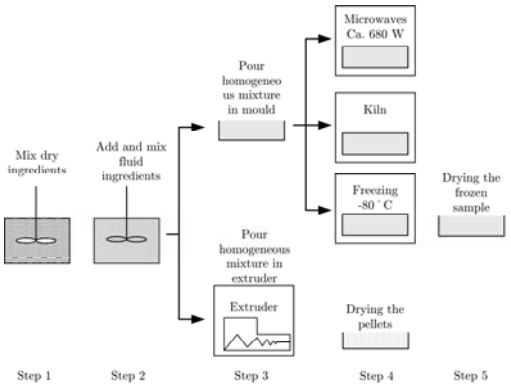
Projektleiter: Dr. rer. nat. Michael Baune

Gesamtkosten: 214979,20 €

Anteil Bundeszuschuss: 148044,20 €

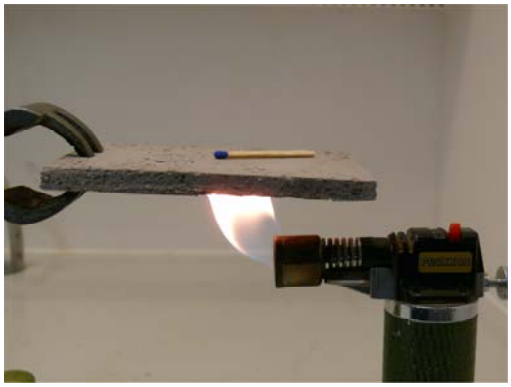
Projektlaufzeit: 01.12.2009 bis 31.08.2012

Pictures



Pic. 1: Developed production routes for paper products based on cellulose-containing materials.

Pic. 2: Paper panel containing 5 % flame inhibitor, produced with leavening agent.



Pic. 3: Paper dust panel containing 5 % borates.

Pic. 4: Hydrophobic paper dust panel.

Pic. 5: Small paper panels, produced by Freeze Gelation.