Research Institute:

PTS Heidenau
Pirnaer Str. 37
01809 Heidenau

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Franziska Gebauer
Tel: 03529 / 551-697
Fax: 03529 / 551-889
E-Mail: Franziska.Gebauer@ptspaper.de

Research area: Product aims

Paper, paperboard and board // technical speciality papers

Key words:

air filtration, spunlace

TITLE:

Controlling specific properties of paper wet laids for air filtration by means of hydroentanglement

Background/Problem area

Filter materials for air filtration are increasingly made from non-wovens comprised of synthetic or glass fibers rather than from paper, which has been made possible mainly by the better dust holding capacity and new manufacturing processes ranging from spunbond technology to the electrospinning of nanofiber layers. The new materials have strongly improved the filtration efficiency, but the synthetic or glass fibres used have some disadvantages as well: One is their petroleum-based raw materials and resulting fixed prices, whereas all other components can already be produced sustainably. At this point it must be stressed that paper-based wet laid nonwoven filter media should be made from renewable raw materials. However, it is not the aim of this project to perform a life-cycle analysis. The use of paper-based instead of glass fibre filters leads to dramatically higher pressure losses and thus also operating costs (80% of the operating costs are caused by energy costs due to pressure losses). Paper will only succeed as an air filter material if the pressure losses can be limited to the level of synthetic- or glass-fibre based filter materials and if they reach comparable performance characteristics.

In this project, technologies will be developed for producing multi-layer paper-based-wet laid nonwovens by means of hydro-entanglement. The wet-laid nonwovens will be converted to novel and functionalized paper filter media that can be used to make deep filtration air filters from renewable raw materials and with performance characteristics and performance data comparable to synthetic- / glass-fibre-based filter media. The novel air filter media should offer high filtration efficiency and dust holding capacity as well as comparatively low pressure losses at high layer thickness.

Objectives/Research results

The project aim is to control the porosity of paper by reorienting its fibres through hydro-entanglement in the paper machine in order to develop novel multi-layer paper based filters with low pressure loss for air filtration applications. The following issues will be dealt with in the project:

- Analysing the influence of fibre properties (type, length, stiffness, fibrillation) on the effect of hydro-entanglement on paper properties for the control of pressure losses in air filtration applications

- Analysing the effects of various additives (polyelectrolyte and metal-containing fibrids) and of fibres with different properties (bonding capacity, stiffness, fibre length, specific area, type of modification) on the filtration efficiency / specific performance of the filters produced

- Identifying the converting steps needed to achieve maximum filter efficiency / specific filter performance with the papers produced

First laboratory investigations have shown that pressure losses may be reduced by hydro-entanglement and the selection of suitable fibres. The targeted use of specialty fibres has made it possible to control the porosity of papers. The use of metal-containing fibrids led to the envisaged metal contents required for microbial growth prevention.

The results were then used for the pilot-scale production of wet-laid nonwovens, using promising natural and synthetic fibres separately and in mixtures. Further investigations dealt with the effects of metal-containing fibries and various intensities of hydro-entanglement as well as with drying method variations (contact/through-air drying).

Further work will be dedicated to the paper-technological characterisation of nonwovens, and to evaluating their filtration properties. Promising samples will be used to obtain demonstrators for air filter testing.

Application/Economic benefits

The air filtration market grows steadily and continuously, driven by the effects of fine dust pollution on human health. This problem will become even more important in future because air pollution levels and also the requirements to indoor air quality can be expected to increase especially in Asia and urban areas.

According to present studies, the global filter production is expected to grow annually by 6.2% until 2018. Completely bio-based filters made from renewable raw materials could reach a market volume of 300 million EUR in Western Europe in the next years. This will certainly take some time, but there are chances particularly for small and medium-sized companies to fill this market. Possible applications include:

- air filters for air conditioning systems

- air filters for industrial plant systems

This could generate a new product range in the industry and in Germany.

Period of time: 01.01.2016 – 30.06.2018

Remarks

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