Sächsisches Textilforschungsinstitut e.V.

Affiliated institute of the University of Technology Chemnitz

Managing Director: Dr. Heike Illing-Günther
Annaberger Straße 240 | 09125 Chemnitz | Germany I Phone: +49 371 5274-0 | Email: stfi@stfi.de I www.stfi.de

Development of hydrolysis-resistant hotmelt adhesive composites for process air and air conditioning applications in compliance with hygiene requirements

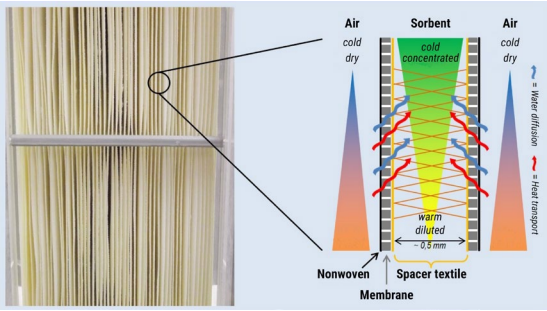
Objective

Ventilation systems require energy to move and heat the air. Humidification and dehumidification processes are particularly energy intensive due to the high evaporation/condensation heat of water. Textile membrane heat and material exchangers based on liquid sorption are an energy-saving alternative. These are hot-melt composite materials consisting of a spacer fabric (through which the liquid sorption medium flows) with membranes laminated on both sides (for water vapour transport). Energy consumption is up to 38 % lower than conventional systems. Proof of function has already been demonstrated with prototypes. However, there are problems with the hydrolytic stability of the materials, hygiene requirements and industrial production.

The aim of the research project was to develop hydrolysis and chemical resistant hot melt adhesive composites for process air and air conditioning applications, taking into account hygiene requirements.

Approach and results

The project developed composites consisting of three (membrane/2D knit/membrane) or five layers (three layers + two outer nonwoven layers). These were characterised by hydrolytically stable and hygienically optimised materials. The 2D knitted fabric consisted of polyester and was permeated with a 40 % aqueous LiCl solution (sorption medium). Polyurethane/polytetrafluoroethylene and polyethylene membranes were successfully used as waterproof and water vapour permeable separation media. A calendered polypropylene spunbond was used for mechanical stabilisation in the 5-layer laminates. The composite was produced using reactive polyurethane hot melt adhesives in a selective roll application process. The water vapour permeability of the composites was determined as a function of temperature and air flow, and the internal pressure stability (bursting behaviour) was determined. In addition, procedures were developed for assembling the individual composites into membrane stacks (edge sealing and media connections of the individual composites). Based on these results, a project demonstrator was designed and manufactured.



Textile membrane fabric and heat exchanger (left) with functional diagram (right)

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Contact: Dr. rer. nat. Ralf Lungwitz Phone: +49 371 5274-248 Email: ralf.lungwitz@stfi.de

www.stfi.de

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