“Zukunft Bau” – The Future of Construction

Short report

HIGH-TECH MEMBRANES FOR HYGIENIC, ENERGY-SAVING HUMIDIFICATION OF ROOM AIR

Occasion / Initial situation

Low humidity levels have proven to be one of the most common causes for complaint when it comes to the quality of air in office buildings. If humidity levels are too low, this increases the risk of illnesses and leads to high follow-up costs. All of the solutions available today involve extensive technical work and consume a considerable amount of energy. This investigation will therefore focus on ionomers, which have the potential to resolve the existing issues with some interesting prospects.

Aim of the research project

The aim of this research was therefore to investigate the usefulness of these high-tech membranes and determine their performance parameters with regard to the humidification of room air in buildings. To this end, a total of 6 functional models were developed, produced and measured for various operational purposes together with the industrial partners.

Figure 1:
Functional models in a test setup.

The VANADion® membranes were identified as the most suitable representatives from the group of ionomers for the technical applications. Other commercially available membrane solutions with similar performance potential were also used by way of comparison. These included popular textile-based solutions (such as GORE-Tex®) as well as solutions from the construction sector (such as Tyvek®).

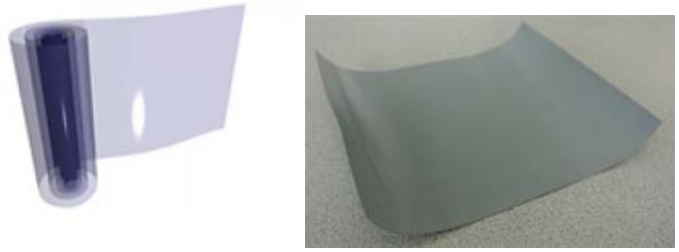

Figure 2:
Material samples for Nafion® and VANADion®.

In each of the test series, VANADion® demonstrated exceptional humidification potential and outstanding technical applications in the purpose-built functional models. The aim was to achieve an increase of around 10% in the relative air humidity. This is based on a start condition of 20% relative room air humidity, which is often the situation in our part of the world when outdoor temperatures are low, and a target value of 30%, which represents the minimum relative air humidity considered to be comfortable.

Two solutions for direct incorporation into the airflow of a mechanical ventilation system each achieved an increase of around 5–7% relative humidity; however, the membrane had a minimally effective transfer surface. This can be increased slightly by extending the humidification components. In spite of its extremely compact design, another decentralised solution model yielded positive results as an attachment for a single-panel standard radiator. This involved dispensing with any technical power units and additional heating power, as it relies exclusively on the convection generated by the heater and the available heat for humidification. This solution is incredibly straightforward to retrofit.

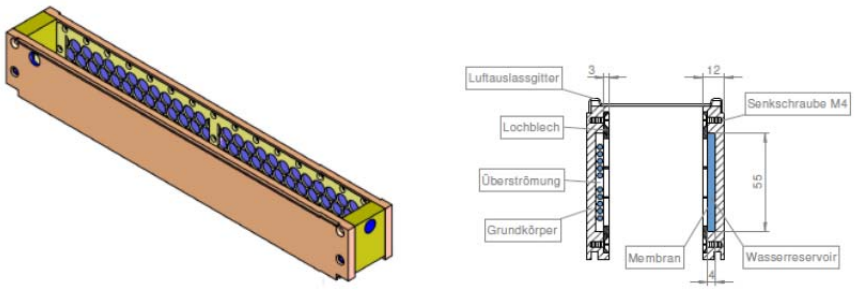

Figure 3:
3D design drawing and functional construction of the decentralised humidification solution.

In terms of air hygiene, it was possible to establish that the membrane provided reliable protection against the transference of pollutants from the humidification water into the air. Nevertheless, it is possible for impurities to build up on the air-side surface if the level of ventilation is too low (due to stoppages without a water seal, for example) and the membranes are used extensively without being cleaned or replaced. All in all, in spite of the excessive level of pollutants under the test conditions, only a very small amount of bacteria was identified. Where certain maintenance cycles were observed, there were no signs of bacterial exposure on the surfaces. The membrane is easy to clean on account of its high acid stability. Its service life could be increased further still without the need for maintenance through additional bactericidal layers on the membrane surface.

The other membrane solutions from the textiles and construction sector, which were also investigated for comparative purposes, demonstrated significant hygiene issues in the first instance and lower performance values than VANADion® in the second.

Conclusion

The solutions that formed the object of this investigation generally highlighted an extremely interesting implementation potential for industrial applications. The functional models that were developed serve to demonstrate the possibility of a centralised application within traditional ventilation systems in addition to a decentralised, manual application in combination with a radiator. The decentralised option is already proving popular thanks to its simplicity and impact,

not to mention the fact that there is still room for improvement. The solutions permit straightforward maintenance possibilities and ensure incredibly energy-efficient operation in comparison to other conventional products on the market. The humidification performance can be controlled with ease via the water temperature whilst avoiding any cooling of the airflow.

Basic parameters

Brief title: H Control

Researcher / Project Management:	MBA Dipl.-Wirtschaftsingenieur (FH) Thomas Kirmayr, Fraunhofer Institute for Building Physics
Industrial partners:	Vaillant GmbH, Westaflex GmbH, Kurecon
Total costs:	€498,729.58
Share of federal subsidy:	295,629.58
Project duration:	27/04/2015–27/10/2017